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An Econometric Analysis of Arms Transfer to the ASEAN Countries

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AN ECONOMETRIC ANALYSIS OF ARMS TRANSFERS TO THE ASEAN COUNTRIES

by

Sapto J. Poerwowidagdo

September 1980

Thesis Advisor: D. C. Boger

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An Econometric Analysis of Arms Transfers to the ASEAN Countries

by

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Major, Indonesian Navy
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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

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September 1980

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An econometric analysis was carried out on military expenditures and arms imports data for ASEAN (Association of Southeast Asia Nations) countries using both single and simultaneous equation models. A forecasting model was developed following the econometric model. Both models were applied to actual arms transfers data for observations during 1968-1976. The empirical result of the econometric model demonstrated the simultaneity of the two variables above and the result of the forecasting model encouraged the use of the lagged variables to predict the values of military expenditures and arms imports. Both models are useful in the policy analysis of the arms transfers within the ASEAN countries.

TABLE OF CONTENTS

I. INTRODUCTION ---------- 9

II. LITERATURE REVIEW ---------- 10

A. ASEAN BACKGROUND AND ENVIRONMENT ---------- 10

1. Historical ---------- 10

2. Geographical ---------- 11

3. Socio-economical ---------- 13

4. Political ---------- 22

5. Military ---------- 27

B. ARMS TRANSFER ---------- 31

1. In General ---------- 31

2. Arms Transfers Within ASEAN Countries ---------- 34

III. THE MODELS ---------- 37

A. ECONOMETRIC MODEL ---------- 37

1. Structure of the Single Equation Model ---------- 38

2. Structure of Simultaneous Equations Model -------- 39

3. Sample and Data Collection ---------- 43

4. Test of Pooling, Heteroscedasticity and Existence of Serial-Correlation ---------- 44

5. Results of Final Estimation for Single Equation Model ---------- 51

6. Results of Estimation for Simultaneous Equation Model ---------- 51

B. FORECASTING MODEL ---------- 59

1. Structure of the Model ---------- 60

2. Forecasting Accuracy Test ---------- 60

3. Empirical Results ---------- 65

IV. ANALYSIS OF RESULTS ---------- 67

A. ON INDIVIDUAL COUNTRIES ---------- 67

1. Indonesia ---------- 68

2. Malaysia ---------- 69

3. Philippines ---------- 70

4. Singapore ---------- 72

5. Thailand ---------- 73

B. ON THE ASEAN ALLIANCE AS A WHOLE ---------- 75

V. CONCLUSION ---------- 84

LIST OF REFERENCES ---------- 86

INITIAL DISTRIBUTION LIST ---------- 87

LIST OF FIGURES

Figure No.		
II.1	The map of the ASEAN countries	12
II.2	The histograms of the populations and GNP per capita of the ASEAN nations, 1978	15
II.3	The plots of the populations of armed forces (PAF) data 1967-1975 of the ASEAN nations	28
II.4	The plots of the military expenditures (ME) data 1967-1975 of the ASEAN nations	29
II.5	The plots of the arms imports (AI) data 1967-1975 of the ASEAN nations	35
III.1	The plots of residuals of OLS estimation on military expenditures in the ASEAN nations	52
III.2	The plots of residuals of OLS estimation on arms imports in the ASEAN nations	53
III.3	The block diagram of the arms transfer forecasting model	61
III.4	The forecasted vs. actual percentage of change in the forecasting model	63
IV.1	The plots of the predicted values of military expenditures in econometric model	78
IV.2	The plots of the predicted values of arms imports in the econometric model	80
IV.3	The plots of the forecasted values of military expenditures	81
IV.4	The plots of the forecasted values of arms imports	82

LIST OF TABLES

Tables No.		
II.1	The areas of the ASEAN countries ----------	13
II.2	The population and GNP per capita of the ASEAN nations ----------	14
II.3	The military power of the ASEAN nations, 1978-1979 ------	30
III.1	The data set for the econometric model af arms transfers to the ASEAN countries 1967-1977 ----------	45
III.2	The range of the Durbin-Watson statistics ----------	51
III.3	The Durbin-Watson statistics of the OLS estimation on arms transfers model from the individual ASEAN countries ----------	51
III.4	The results of the single equation model of the military expenditures within the ASEAN countries ----------	54
III.5	The results of the single equation model of the arms imports within the ASEAN countries ----------	56
III.6	The results of the arms transfers econometric model -----	58
III.7	The results of the arms transfers forecasting model -----	65
III.8	Steps and results of the accuracy tests of the individual countries forecasting model ----------	66

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I. INTRODUCTION

Since the downfall of South Vietnam, Cambodia, and Laos to the communists, the USA and Western countries have decreased their direct involvements in Southeast Asia. Indirectly, there has been a slight increasing of the flows of arms to the non-communist countries in this region.

This thesis develops, via econometric analysis, the issues of arms transfers specifically into ASEAN countries, all of which are non-communist countries.

Chapter Two reviews the background of ASEAN, its historical, geographical, socio-economical, political and military aspects. It also reviews arms transfer in general and specifically within ASEAN nations.

Econometric and forecasting models are built up and examined in the third chapter.

Chapter Four analyzes and discusses the results for individual countries and for ASEAN alliance as a whole.

The last chapter concludes the analysis and discusses the possible future use of the results on applications of forecasting and policy analysis.

II. LITERATURE REVIEW

In this chapter, two areas of interest will be reviewed to give the reader the background of the ASEAN and arms transfers before entering the next chapters on the econometric side.

A. ASEAN BACKGROUND AND ENVIRONMENT

Historical, geographical, socio-economical, political and military aspects are the five main points to be described to reveal the ASEAN background and environment.

1. Historical

In 1961, three of the Southeast Asian countries, Malaysia, the Philippines and Thailand, linked themselves in the Association of Southeast Asian States (ASA). ASA was successful in creating the nucleus of a regional association, ASEAN, the Association of Southeast Asian Nations, established in Bangkok in 1967. In addition to the three countries of ASA, ASEAN also included Indonesia and Singapore. [1]

The real purpose of ASEAN was to enable the new government of Indonesia (post-Soekarno) to participate in an association for regional development on equal terms with the ASA members. Singapore, which had refused to join ASA was fortuitously able to enjoy the same privilege; it could scarcely remain away from any regional organization in which Indonesia took part, because this city (island) state hoped to promote its own economic development through helping to rebuild the shattered Indonesian economy. Consequently, as the most highly-developed state, Singapore has perhaps the most to gain from greater regional integration,

and so has been one of the organization's most active members.

ASEAN has established a regional identity within the United Nations Economic and Social Council for Asia and the Pacific (ESCAP, formerly ECAFE). ASEAN has some modest schemes of cooperation in transport and communications, fisheries, and education to its credit. ASEAN has achieved a modest success in promoting certain aspects of the more obvious and necessary forms of cooperation such as postal service and telecommunication, transport facilities, fisheries and agricultural techniques and has achieved some success in promoting higher scientific and technical education in institutions serving the region as a whole.

With the expiration of SEATO (Southeast Asia Treaty Organization: Thailand, Philippines, Pakistan, USA, Britain, New Zealand and Australia) in 1975 and the fall of South Vietnam to communists, the USA and Western countries viewed ASEAN as a balancing regional power against the spreading communist expansion in this region. For that reason, arms transfers from Western countries to ASEAN countries has been increasing considerably in recent years. [1]

2. Geographical (see Figure II.1)

Archipelagic Southeast Asia presents perhaps the greatest geographical complexity in the world. It lies around the margins of two continental masses. The low latitudinal position of Southeast Asia, the broad extent of the intervening seas on its archipelagic fringes and the deep embayment of the mainland ensure a high degree of climate uniformity. The continuously warm and humid condition typical of equatorial lowlands are experienced over a very large part of Southeast Asia. Uniformly high temperatures and heavy torrential precipitation result

FIGURE II.1

The map of the ASEAN nations

in a very rapid erosion and deep chemical weathering. This tropical condition has been a major consideration in the arms transfer transactions into this region, i.e., a special modification to adjust to the tropical condition is necessary when producing a particular weapon to be transferred to this region.

Its geographic location is along the sea lanes between the Indian and the Pacific Oceans and the crossroads of Asia's two high cultures, India and China. It covers 1.2 million square miles of land and this land is distributed among the ASEAN countries as shown in Table II.1.

Table II.1. The areas of the ASEAN countries. (in square miles)

Indonesia	782,663
Malaysia	127,316
Philippines	115,830
Singapore	226.4
Thailand	195,455
TOTAL	1,221,490.4

3. Socio-economical

The socio-economical aspect of the ASEAN countries is much affected by the size of the population in this region. This region holds 5.38 percent of the world's population, and Indonesia has more than half of that population. [3]

The average real rate of growth of GNP in '74-'75 in this region was: Indonesia, 7.8 percent; Malaysia, 6.0 percent; Philippines, 5.8 percent; Singapore, 6.8 percent and Thailand, 4.5 percent. An important question in this region is the much debated problem of whether growth in the Third-World "trickles down" or whether the rich get richer and the poor get poorer. This question certainly can create socio-economic problems in this region. Besides the problem of distribution of social wealth, which has not yet been solved in ASEAN, another issue likely to have an increasingly great impact on the political dynamics of those countries is the frustation and alienation that the educated are bound to experience as they become aware how modest the expectations are that they can realistically entertain and how far behind the affluent countries they will remain throughout their lifetimes.

The distributions of population and GNP per capita of the ASEAN countries in 1978 are shown in Table II.2 and in Figure II.2.

Table II.2. The population and GNP per capita of the ASEAN nation.

Country	Population (million people)	GNP per capita (dollars)
Indonesia	141	240
Malaysia	13.0	860
Philippines	46.3	410
Singapore	2.3	2700
Thailand	45.1	380

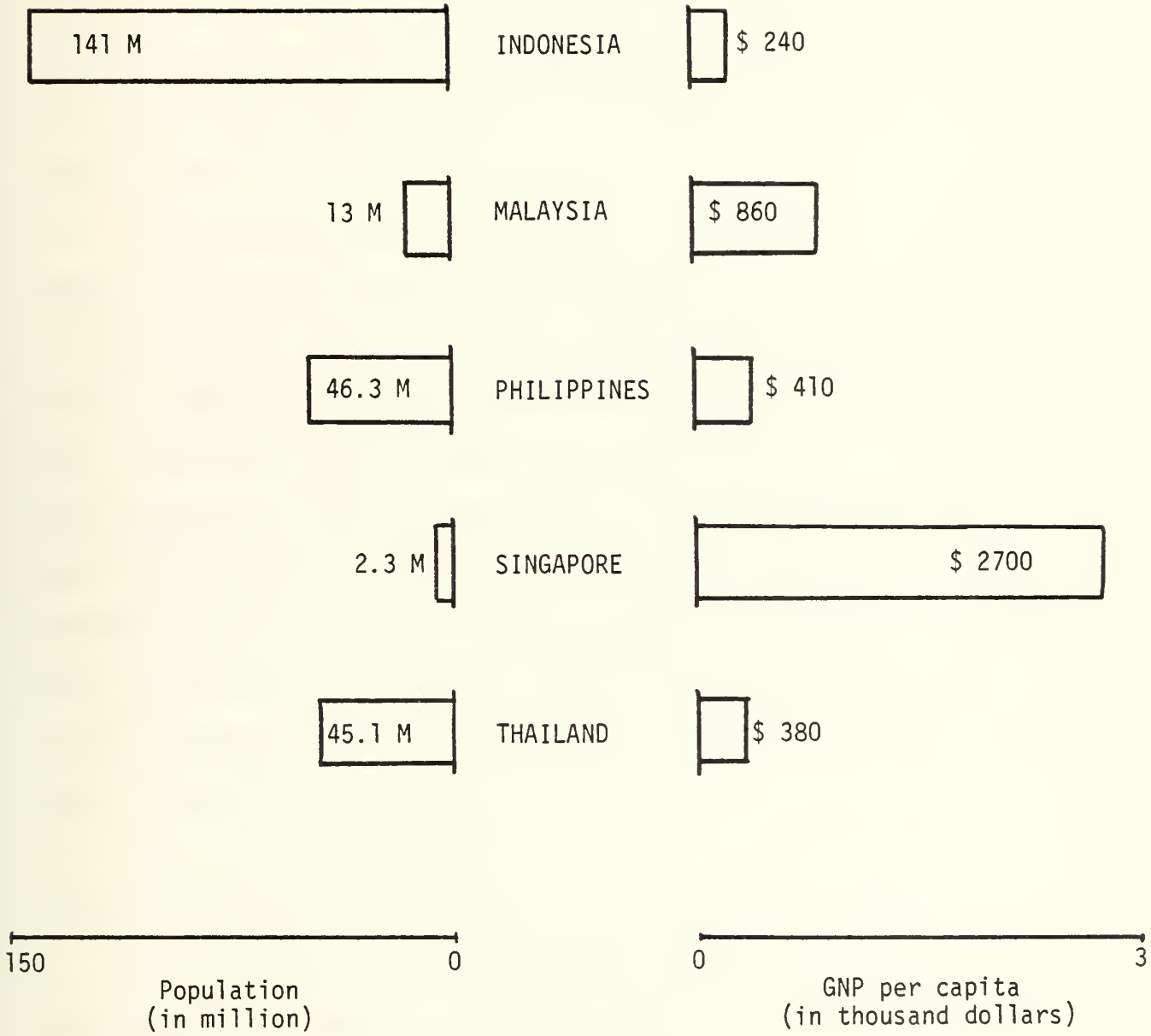


FIGURE II.2

Histograms of the population and GNP/capita
of the ASEAN nations.

These data indicate that in ASEAN, the size of population is inversely proportional to the wealth/living standard of the people in the country.

Control of population in ASEAN is becoming very important. The success of international, national and private efforts to create support for population control policies, the well-publicized accomplishments of Singapore's family planning programs have heightened awareness of population issues.

The economic growth of four countries of ASEAN (excluding Indonesia) comfortably exceeded the five percent growth target of annual increases GNP set in the United Nations First Development Decade in the sixties. Despite its miserable economic performance in the earlier years, even Indonesia had exceeded this growth rate by 1970. All of these countries in 1974 appeared likely to attain the 6 percent per annum goal set in the Second Development Decade in the seventies. Nevertheless, the maintenance of these growth rates, and their attainment in other parts of the region, necessitate continued close commercial and financial relations with the West and Japan. The USSR is both unable and unwilling either to provide the enhanced capital requirements or to absorb the greatly expanded exports that such development would involve; China is even less capable of providing such services.

The Organization of Petroleum Exporting Countries (OPEC), of which Indonesia is a member, has won successive large price increases in 1972 and after. The differential effects of these changes in commodity prices on export incomes within the region was to sharply accentuate the existing imbalance. Malaysia, Singapore and Indonesia

all did well in maintaining the GNP growth rate. With rocketing oil prices, Indonesia and Malaysia (a newcomer in the ranks of oil producers) did substantially better. For Thailand and the Philippines, the rise in oil prices threatened to completely wipe out their foreign exchange reserves.

Among major trading nations, it is Japan that has become of greatest importance to ASEAN and vice versa. Japan received around 10 percent of its total imports from Southeast Asia in 1971 and in return sent nearly 9.5 percent of its exports. If energy-short Japan wishes to reserve for itslef a special place in ASEAN's potentially very large oil and gas resources, some re-accomodation with the legitimate national development goals of ASEAN countries appears essential.

Although ASEAN does not assume any real importance from the standpoint of the direction of world trade, it nevertheless remains a significant producer of several commodities such as tin, bauxite, iron ore, and copper. In many products of tropical agriculture, Southeast Asian countries hold a commanding position. ASEAN still accounts for more than 80 percent of world exports of pepper, cassia, nutmeg, maize and quinine. Although it produces much less rice than either South or East Asia, Southeast Asia nevertheless generates some 40 percent of world rice exports and it is a notable exporter of coffee, tea, sugar, coconut oil and palm oil. More than 85 percent of natural rubber originates from that region. [2]

The leaders of ASEAN countries have realized the necessity to speed up the pace of industrialization. Concern for this goal reflects the priorities assigned to economic growth, expanded employment

opportunities outside agriculture, qualitative improvement in human resources, trade diversification etc. Despite the priority maintained for industrial development, progress toward this goal has remained modest and the structures of the ASEAN economies have changed slowly, except in Singapore. Pressures for industrialization are matched by the need to expand food supplies to keep pace with the region's rapid population growth.

Today, the focus of economic nationalism in the region has shifted from the threat to the sovereignity of the host country arising in the activities of resident aliens and foreign direct investment enterprises to concern for excessive dependence upon Japan as a source of imports and as a market for exports.

If the coming decade sees no substantial escalation in levels of outside support for internal dissidence and no open warfare, the structure of economic concerns and priorities, which have become prominent in ASEAN countries, will continue to preempt the attention of the region's political leaders and the resources at their disposal. Under these circumstances, economic expansion in the pattern of that quarter century will continue, a process which will support modest industrialization and contraction in the shares of aggregate income generated by agriculture and foreign trade activities. On the other hand, if past rates of growth in per capita real income are maintained while the pattern of income distribution remains stable, it will mean that the modest economic growth taking place will be widely distributed and will make a contribution to social stability.

The main problem likely to arise in the government of ASEAN countries in this coming decade is to attempt to secure national unity that

transcends ethnic allegiances. Almost by definition this will be seen to benefit certain groups at the expense of others. Current ethnic composition of the ASEAN nations are:

a. Indonesia

Traditionally, non-Javanese such as Balinese, Bataks, Menadonese, Minangese etc. have felt left out of Indonesian's political and economical system. Although Indonesia's prime ministers (unlike Malaysia's) have come from a variety of ethnic groups, the Army officer corps reportedly has become increasingly dominated by Javanese since the ascendancy of the military following the 1965 coup and counter-coup which toppled Soekarno. One of the ways the Army expanded its economic role was by restricting Chinese-owned business (Chinese are about 2.9 percent of population). Nonetheless, non-Javanese might not pose the greatest difficulties for the ruling regime. Some of the potentially most troublesome problems with which the military regime will have to cope involve factional splits among Javanese Army officers themeselves.

b. Malaysia

Since independence the dominant political force in Malaysia has been the National Front, formerly known as the Alliance Party. Originally a coalition of UMNO (United Malays National Organization), which was primarily Malay; MCA (Malaysia Chinese Association), which was primarily Chinese; and the less powerful MIC (Malaysian Indian Congress), which was primarily Indian. Since 1969, Malay domination in this coalition has grown. The civil service, particularly at top ranks, is heavily staffed by Malays, although Chinese and Indians can be found in technical services. The police and the army are largely Malays, although

Chinese and Indians can be found in technical services. The police and the army are largely Malays, although the air force, which has many Chinese pilots, is less so. Certain cabinet portfolios are traditionally held by non Malays. The Minister of Housing, for example is Chinese and the Minister of Telecommunication is Indian, whereas the Ministries of Interior, Defense and Foreign Affairs are always controlled by Malays. A significant number of Malay ascendancies since 1969 have been reflected in the awarding of the Finance Ministry portfolio, which for 20 years had been in Chinese hands, to a Malay. Perhaps the most important implication of these trends for the future is that the growing Malay political dominance will give Malays increasing influence over the national economy.

c. Philippines

The regime of Marcos is not easily ethnically labelled as other governments in the region, except perhaps negatively, i.e., not Muslim and not Chinese, and it is probably not controlled chiefly by non-Luzon groups. Since the traditional support of Filipino politicians has been localist, observers have been noting to what extent Ilocanos (the Luzon linguistic group from which Marcos comes) have benefited from martial law, particularly from the expanding role of the military. Regarding the Chinese minority, the Marcos government has stepped up pressure on the Chinese to declare Philippines citizenship. Many local Chinese already have been assimilated and intermarriage between Chinese and Filipinos is common. Land-reform, ironically, has widened the economic gaps between well-developed regions, such as Central Luzon, and poorer regions, such as eastern Visayas. The most

disaffected ethnic minority is the Muslim community in the Southern islands of Mindanao and Sulu.

d. Singapore

Although Prime Minister Lee Kuan Yew's People's Action Party (PAP) is virtually a Chinese party in a society that is 75 percent ethnic Chinese, the government has been very conscious of both the "Malay Sea" surrounding the city state of Singapore and the vulnerability to regional disturbances of the finance and processing based economy. In particular, Singapore's Chinese leadership is sensitive to the concern of the Malaysian government for its ethnic brethren in Singapore. Thus Lee has taken other steps to soften the resistance of the minority Malays. On the other hand, there have been recent reports that the government has "excused" Malays from military service. Persistent Malay-Chinese distrust has blocked cooperation between the regimes of Malaysia and Singapore.

e. Thailand

The politics of Thailand, both civilian and military, are controlled by ethnic Thais, who comprise 67 percent of the population. Of the minorities, the Chinese are commercially preeminent, often providing Thai politicians with lucrative business opportunities in exchange for government tolerance. Minorities in the North and Northeast are hill peoples traditionally ignored by the lowland majority. Thai Meo people have become the focus of anxiety on the part of the central government, because of their alleged alliance with communist dissidents along the strategic border areas.

In the South the most visible ethnic minority has been the Malay Muslims residing along the Malaysian border. Officers and police governing the province, where the Malays are prevalent, are ethnic Thai. [4]

4. Political

From the description in the previous sections, the social problems, i.e., ethnic disputes, in ASEAN might turn out to be the primary political problems among the governments in the region. To a great extent the normalization of politics among the nations on mainland Southeast Asia will depend upon finding ways to resolve ethnic problems among common borders. It is most unlikely that resolution through police operations alone will bring peace. Although ASEAN potentially could serve as a vehicle for solving ethnic disputes which have grown into disputes among states in the region, it will probably be unable to do so until a reduction in current conflicts enables it to develop into a truly cooperative body. The evolution will be difficult for several reasons:

a. ASEAN's membership is too limited to be able to represent the Southeast Asia region, since it does not include Laos, Vietnam, Cambodia, Burma, Brunei and Papua New Guinea.

b. ASEAN's member nations do not especially trust each other and have differences in achieving the objectives of ASEAN.

c. ASEAN's present members are rather careful of rushing too quickly into burdening the organization with more functions than it can handle.

Some interesting developments of relationships between ASEAN countries and external powers such as the US, Soviet-Union, China, Japan,

Vietnam etc. are briefly described below to enhance the knowledge of the political situation in this region.

After years of taking US interest in Southeast Asia for granted, ASEAN countries tend to take disinterest for granted. After years of being overly concerned, the US tends to be under concerned. Nevertheless, with some Indonesian efforts to lobby for US understanding, the US is now upgrading the level and intensity of ASEAN-US contacts. Among the main worries of the ASEAN countries toward the US are that the US should resist internal protectionist sentiment, maintain bases in Philippines, sustain US-Japan alliance, and seek to influence the Indochinese situation. US stresses on political human rights create irritation and resentment among ASEAN countries. Much more sustained and thoughtful effort is required on both sides in order to promote and enhance mutual interests.

While ASEAN diplomatic relations with the Soviet Union began developing first, China has made more headway in the past few years, both diplomatically and in trade. ASEAN nations are disinclined to support the Soviet concept of collective security against threats that ASEAN does not perceive. The Soviets are disinclined to support the ASEAN concept of a neutral zone which aims at preventing any one power from becoming a threat. Yet, the Soviets have criticized ASEAN as a US-backed military alliance. This relationship is uncertain but may be improving. The way the Soviets play their hand with Hanoi in relation to China, Laos and Cambodia will be a key determinant of the degree of warmth in ASEAN-Soviet ties.

Sino-ASEAN relations are additionally complicated by varying degrees of overseas-Chinese assimilation on one hand and varying degrees of attraction exercised by Chinese on the other. The fact that China insists upon party-to-party relations co-existing with state-to-state relations makes the ASEAN countries worry about Maoist insurgencies. Malaysia, Thailand and the Philippines have established diplomatic relationships with China, but Indonesia, because of the abortive coup by the Indonesian Communist Party backed by China in 1965, is still reluctant to do so. Singapore, which is politically dependent upon Indonesia, waits to be the last one to establish diplomatic relationship with China.

Japan's economic drive in Southeast Asia persists while its US and EEC competitors are more spasmodic in their ASEAN efforts. Too much Japanese stress on bilateral relations will foster suspicions of "divide and rule". Japan will be slow to subtly encourage ASEAN economic unity which is the only way out of its dilemma.

Vietnam stresses "genuine independence" as it pursues improved ASEAN ties, but ASEAN countries continue to wonder how genuine Vietnam's independence is in relation to the Soviet Union, especially now that Vietnam is a member of CMEA (Council for Mutual Economic Assistance). Grave ASEAN doubts exist about Vietnamese intentions for Laos and Cambodia to have genuine independence. Vietnam promises to abstain from party-to-party relations with ASEAN communist parties will have to be matched by performance. If the US does normalize relations with Vietnam in the near future, it might be a good prospect for continued progress toward better state-to-state relations, plus increasing trade between

Vietnam and ASEAN. If the US does not, and Vietnam-Soviet ties move appreciably closer, then relations are likely to remain cool and correct but not close.

While relationships with external powers find the ASEAN countries nearly united, the internal relationships found among them reflect more of the differences rather than the similarities among the ASEAN nations.

Many Malaysian Malays see Indonesia as their big Malay-Muslim brother, while the present government of Indonesia sticks staunchly by the principles of the secular state. Indonesia worries about Malaysia's inter-racial and security problems. Malaysia perceives that there will be blood-brother help in a major crisis. When Malaysians start talking about what is best for Southeast Asia, or make other self-centered responses, discord is implicit. There is nothing to worry about yet, but it would help more if Malay leaders had a shrewder appreciation of Indonesian political realities.

In Singaporean eyes, Indonesia is politically huge and Singapore small, while in Indonesian eyes, Singapore is economically strong and Indonesia weak. Singaporean perceptions and underlying insecurity have prompted it to a major role in Indonesia's economy which compounds Indonesian feelings of insecurity vis-a-vis Singapore. Singapore has continued to assert itself occasionally in ways that slight Indonesian nationalism. Overall Indonesian economic weakness sustains Singapore in holding back the formalization of diplomatic rations with China until Indonesia unfreezes its Peking ties. This indicates the Singaporean appreciation of the Indonesian political realities.

The Philippines had promised to dissolve their legal dream of claiming Sabah to reduce Malaysian resentment, but the Philippines inability to meaningfully integrate its Muslim minority within the Philippines polity will extend the rebellion and create more problems and irritation for Malaysia beside the claim. (The Philippines claimed Sabah as its territory, based on a disputed document of lease contract, made in 1878, between Sultan Sulu and a representative of a British firm. The British, and subsequently the Malaysian government, claimed that title to the land was leased by the Sultan and his heirs in perpetuity, while the Philippines held that the land was only leased on the basis of payment of annual rental.) [10]

Malaysia and Singapore joined together in haste in 1963 and parted amid politico-communal bitterness in 1965. Both countries were unable to sustain the pre-independence reality of being two political units but one economic unit. Singapore's Chinese majority and Malay minority were back-to-back with Malaysia's Malay majority and Chinese minority. Malaysia and Singapore share a common threat, the Malayan Communist Party, but also a querulous partnership. They have yet to show a greatly improved capacity to anticipate problems and resolve them to mutual advantage.

The main problems of Thailand and Malaysia are the Thai-Malaysia border area, the MCP (Malayan Communist Party) around the border and the Thai-Muslim minority that has its dream of separatism. There is a poor degree of Thai administrative control in the south, which is tantamount to tolerance of MCP remnants and this is often a stimulus to seccessionism among Muslims. Due to the restoration of

Thai-Malaysian cooperation and joint operations against the MCP following the hiatus of 1975, seccessionism is not a very real current threat to Thailand and MCP is a somewhat lessening threat to Malaysian security.

There are no significant problems in the relationships between Indonesia-Philippines, Indonesia-Thailand, Philippines-Thailand, Philippines-Singapore, or Singapore-Thailand. [5]

5. Military

The military is a dominant factor in the political atmosphere in ASEAN countries. Three of the members, Indonesia, Thailand and the Philippines, have a strong military role in their administrations. But the percentage of armed forces in these three countries are relatively smaller than in Singapore and Malaysia. The Philippines and Indonesia used to have less than 3 percent and Thailand has never been above 5.5 percent of the population for their armed forces. Indonesia has shown a declining number of armed forces since 1970. Figures II.3 and II.4 are plots of the population of armed forces and the military expenditures for the five countries in 1968-1977. Some jumps and drops or increasing and decreasing on the plots shows the military situation and atmospheres within ASEAN countries during specific years, e.g., Indochina war, East Timor dispute etc. Some more explanations will be given and discussed in the next chapters. Table II.3 exhibits the military power of the ASEAN nations.

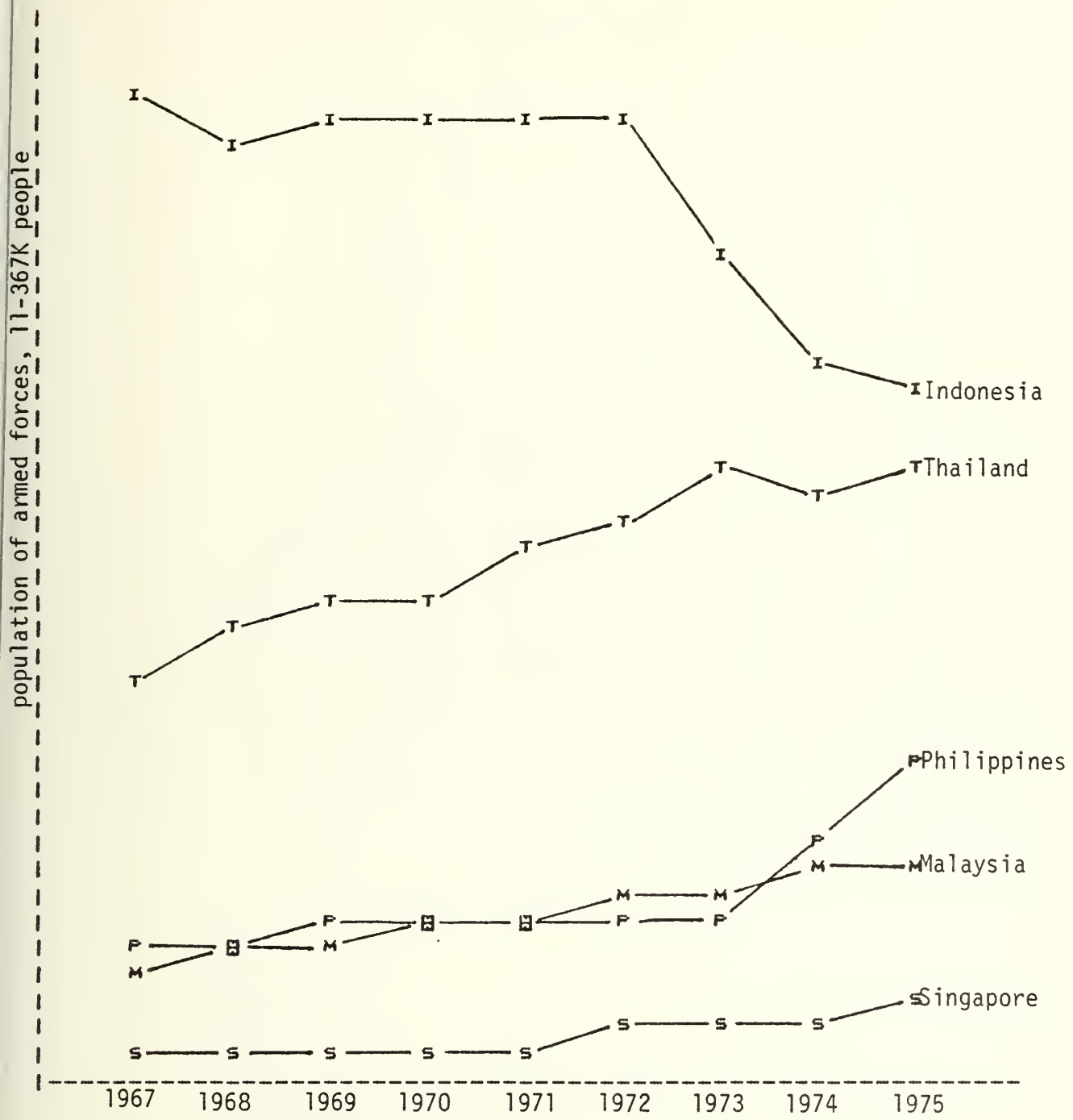


FIGURE II.3

The plots of populations of armed forces (PAF)
data 1967-1975 of the ASEAN countries

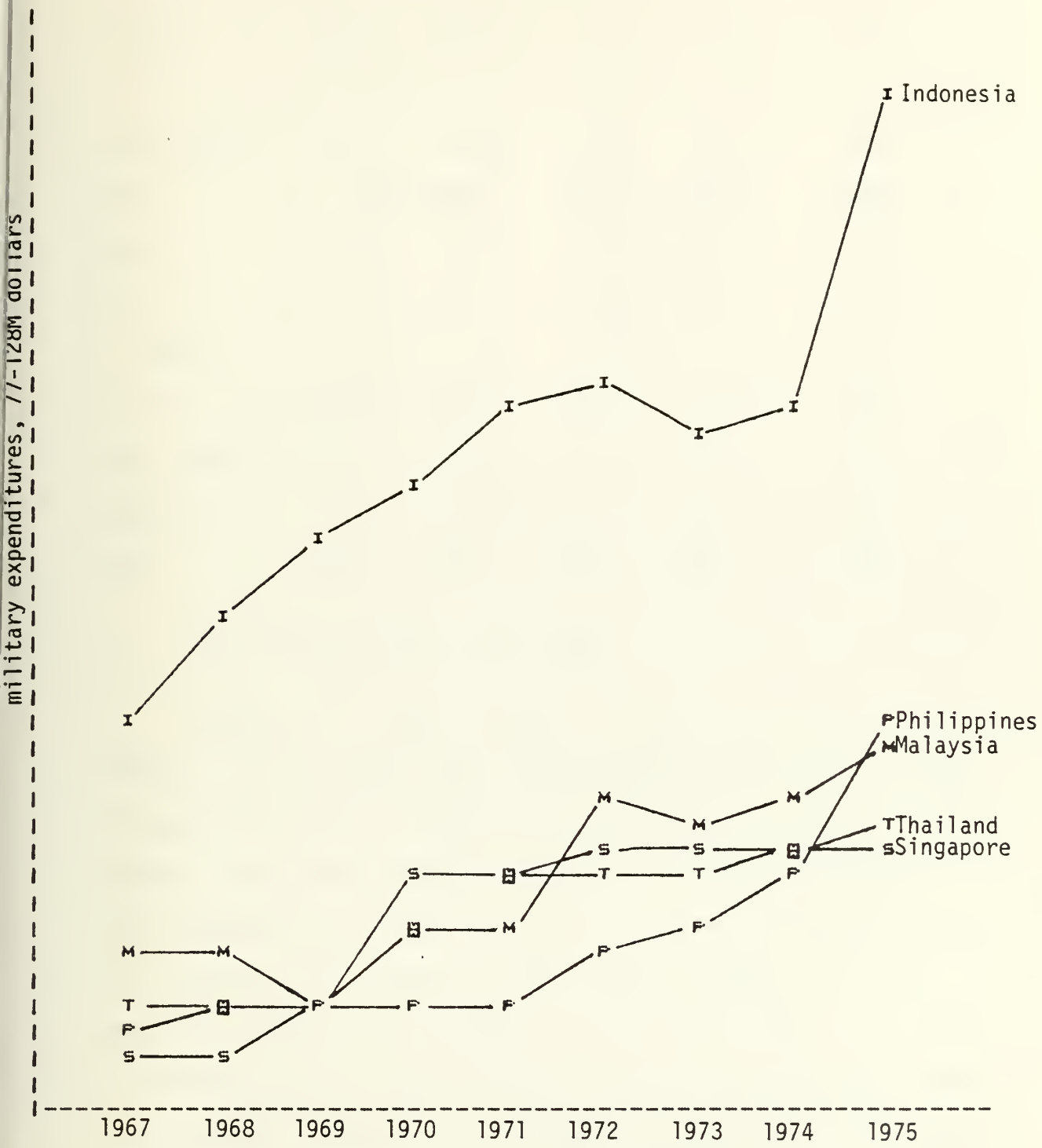


FIGURE II.4

The plots of military expenditures (ME) data 1967-1975 of the ASEAN countries.

Table II.3. The military power of the ASEAN nations, 1978-1979.

Country	IND.	MAL.	PHIL.	SING.	THAI.
Armed Forces	247K	64.5K	99K	36K	212K
MILEX	$1.6B	$699M	$793M	$410M	$746M
Army	180K	52.5K	63K	30K	141K
Navy	39K	6K	20K	3K	28K
Air Force	28K	6K	16K	3K	43K
Reserve	(112K)	(240K)	(185K)	(82.5K)	(566K)
Combat Ships	98	42	77	22	87
Combat A/C	45	36	111	103	149
Tanks	485	400	395	375	453

($K = 10^3$; $M = 10^6$; $B = 10^9$) [6]

Almost in all aspects, except in reserve and combat aircraft, Indonesia has the biggest number among the ASEAN countries. As the most populated country in this area, Indonesia is a candidate for the hegemonic role in the Southeast Asia region, in which Vietnam is a strong candidate, too. But, to catch up with what Vietnam has after the Vietnam war, to balance the power between communists and non-communists in this region, Indonesia and the other ASEAN nations have to carefully and intensively build-up their military strength. Table II.3 above also indicated that Thailand is the second in the military power ranks in the ASEAN. Its reserve and combat aircraft are far above Indonesia's and the other ASEAN nations. As the closest frontier to the communist countries among the other ASEAN nations,

Thailand has to have enough military power to confront and to avoid the possible expansion of the communists. Singapore has 103 combat aircraft, compared to only 45 combat aircraft that Indonesia has. It showed the efforts of Singapore to build up its military power, smartly considering the manpower efficiency. Recent development in Indonesian DOD have required the build-up of the air force, by purchasing more sophisticated combat aircraft. This is a possible response to the situation that is shown in Table II.3.

B. ARMS TRANSFER

The words arms transfer indicate the flows of arms, or weapons hardware, from one nation to another nation. It can be given as grant aid from a stronger nation to its allies or purchased from one by another. This section will review the area of arms transfer in general and in the ASEAN countries specifically.

1. In General

Recently the transfer of military hardware has come into vogue as one way of viewing and measuring international relationships. Some work has been done to derive qualitative measurements of military hardware that has been transferred (by aid or by sale) and to utilize these measurements in making qualitative statement about transfers and about changing military relationships.

The data on the actual military hardware that has been transferred internationally, though sometimes this was not the "real" data, exist in government archives. However, the following statements appear reasonable:

a. Data on the transfer of major combat and transport aircraft and heavy helicopters are available and generally good, in the sense that the types and numbers are usually known.

b. Data on the acquisition of other aircraft are less complete (i.e., trainers, light transports liaison aircraft, light helicopters etc.).

c. Data on the acquisition of naval vessels are very good in terms of when and whether a particular type has been acquired but not good as to exact numbers.

d. Data on acquisitions of missiles are good in terms of when and whether a particular type has been acquired but not good as to numbers.

e. Data on transfers of armor are of very uneven quality, particularly armor acquired as military assistance rather than sales.

f. Data on acquisition of artillery, crew-served weapons, small arms, and essential ancillary equipment such as radar, electronic control equipment and the like are exceedingly spotty.

g. The quality of available data discussed above is not a function of which country originated the transfer, i.e., the donor or sales source.

The recent upsurge in the quantity and quality of arms transfers is of increasing concern to policy makers and policy analysts. Their concern focuses on a series of critical questions which can not be answered without valid and reliable arms transfer data. Those questions can be described as:

- What are the recipient countries' demands for conventional arms?

- What are they contracting for, in terms of numbers, types, mode of delivery and financial arrangement?

- What are the delivery patterns, number and types?

- What is the monetary value of these transfers?

- What is the military capability of the recipient country before and after a specific arms transfer?

Since this paper relates more to the flows into a particular region, i.e., ASEAN countries, some questions related to the impact on recipient countries can be added:

- How do certain types and levels of arms transfers affect local military balances?

- Do arms transfer enhance or inhibit the internal stability of recipient countries?

- What effects do arms transfers have on the economic development of recipient countries?

To be able to answer these questions, one must first obtain valid and reliable data on arms transfers. Some reliable sources of the required Arms Transfers Data Sets are:

- SIPRI (Stockholm International Peace Research Institute), which has World Armaments & Disarmaments SIPRI Yearbook and The Arms Trade Registers.

- ACDA (US Arms Control and Disarmament Agency), which has World Military Expenditures & Arms Transfers data, available yearly for ten years (1967-1976).

- IISS (International Institute for Strategic Studies), which has The Military Balance, annually.

- CIS (Center for International Studies, Massachusetts Institute of Technology), which has "Arms Transfer to Less Development Countries".

- Department of Defense (DOD) publication, Military Assistance and Sales Facts.

- Other sources such as Aviation Week and International Defense Review. [8]

2. Arms Transfers Within ASEAN Countries

The flows of arms transfers to the ASEAN countries are increasing from year to year. This is shown in Figure II.5.a and b which consists of plots of arms imports data of five ASEAN countries for 1968-1977, in 1976 dollars.

As indicated in the previous section, most of the flows of this arms transfer to ASEAN countries came from Western countries, since all five countries are non-communist countries.

The fluctuations of the arms transfers in a particular country such as Indonesia, Thailand and Singapore, which can be seen in Figure II.5a and b, explains a lot about the arms transfer behavior related to the changes of the security situation in this region. Major effects to be noted are the strong involvement of the US in the Indochina war, which ended with the downfall of South-Vietnam, Cambodia and Laos to the communists, and the East Timor dispute.

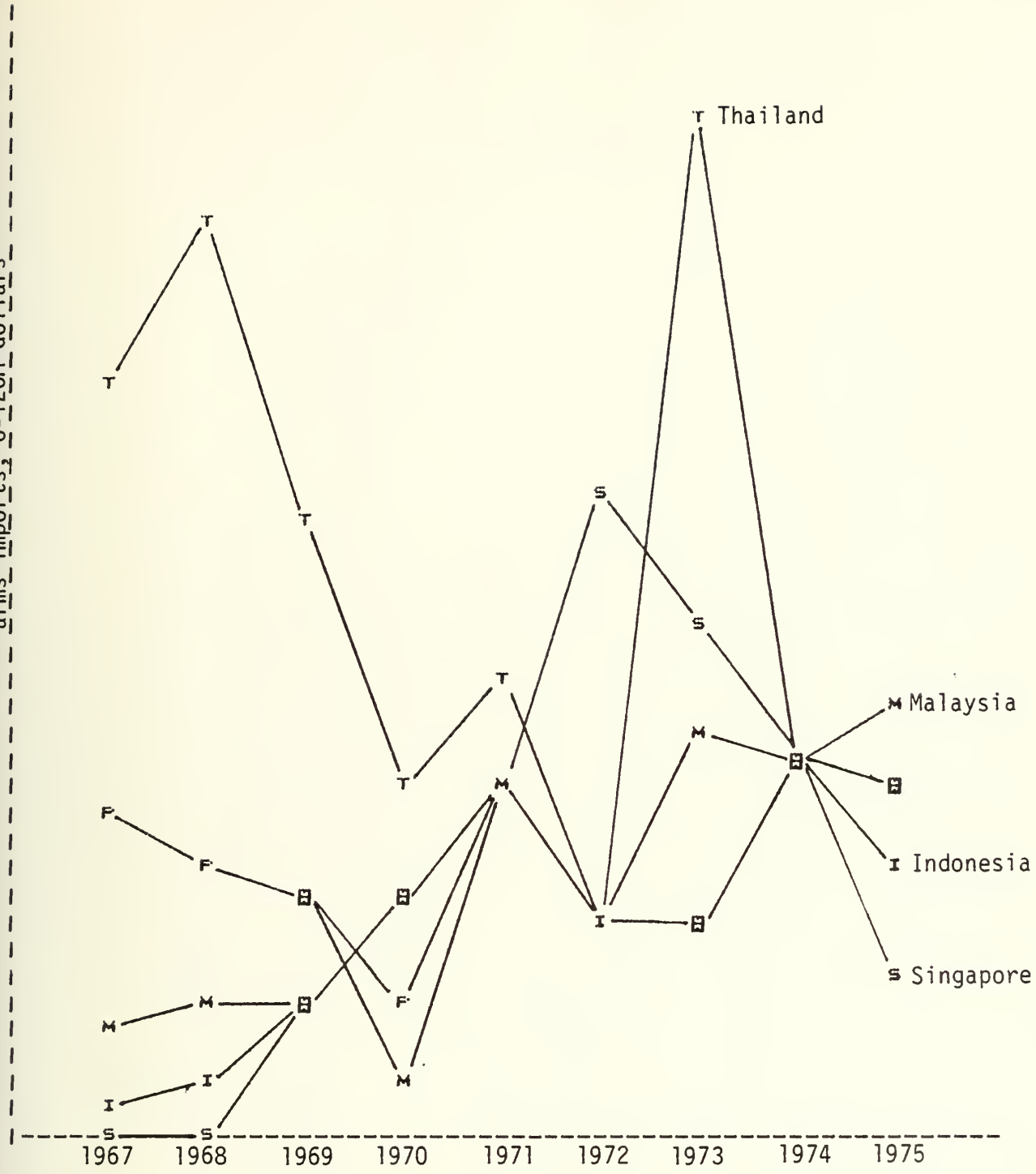


FIGURE II.5a

The plots of arms imports (AI)
data 1967-1975 of the ASEAN countries

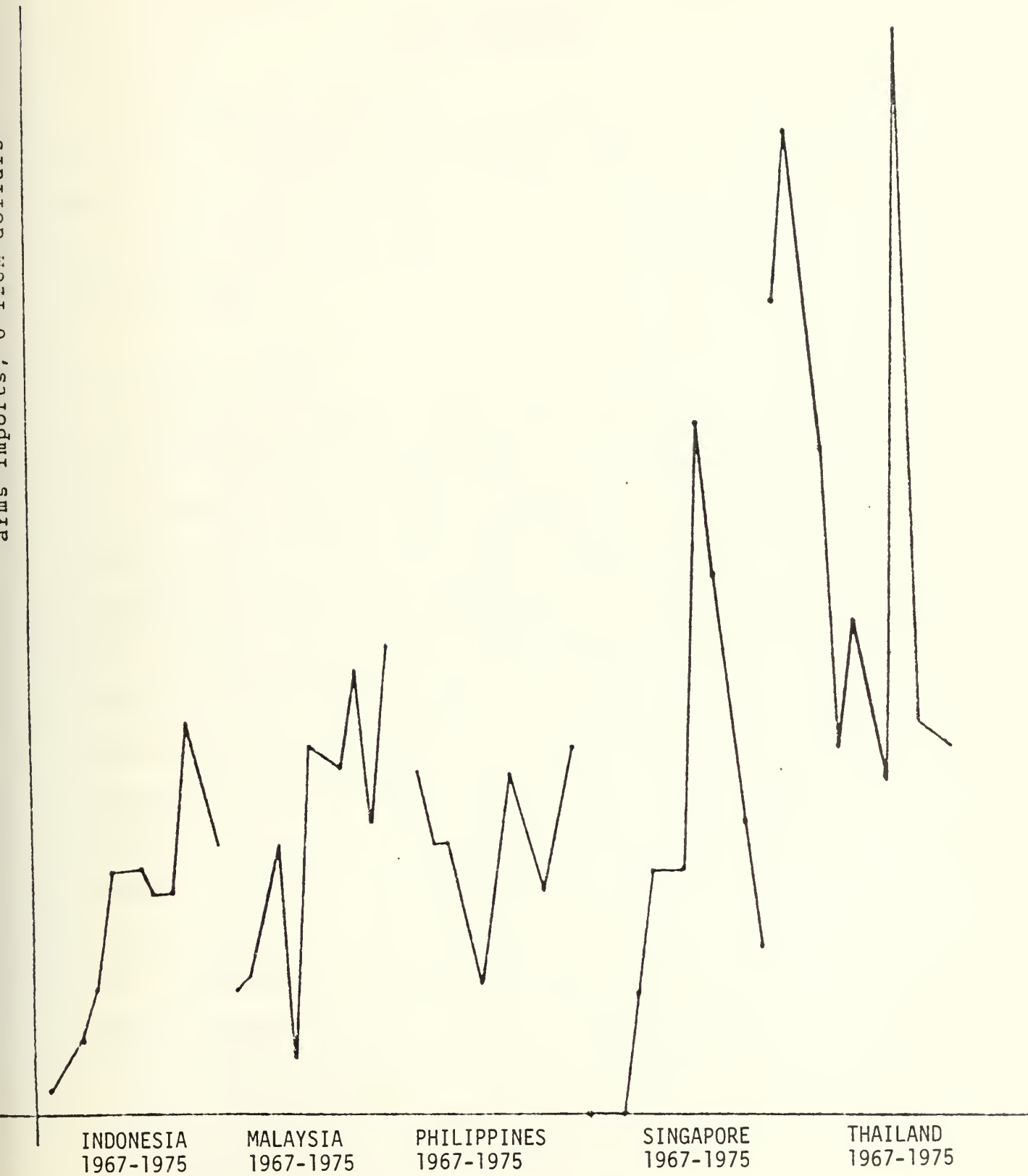


FIGURE II.5b

The plots of arms imports (AI)
data 1967-1975 of the ASEAN countries

III. THE MODELS

As indicated in the title of this thesis, the model which is to be used in this analysis is an econometric model. The forecasting model, which is derived from the econometric model, is useful for predicting the values of some important variables in the entire arms transfers model.

A. ECONOMETRIC MODEL

Two classes of econometric models may be distinguished, single equation and simultaneous equations models. The single equation models consist of one or a series of regression equations in which individual equations are unrelated to each other. The equations are estimated by the method of ordinary least squares (OLS). The simultaneous equations models, however, express casual relationships among the various equations and the endogenous variables in the models. The relationships are determined simultaneously with the solution of the entire system. All econometric models contain variables, which are either endogenous or exogenous, and parameters in a system of structural equations. The endogenous variables are those variables the values for which are simultaneously determined by the model and which the model is designed to explain. The exogenous variables are variables the values for which are determined outside the model but which influence the model. The error terms are random variables that typically are added to all equations of the model. The explicit parameters of the model are the constant coefficients that multiply the variables of the model.

For the arms transfer model there are two significant variables, military expenditures and arms imports, which are to be estimated.

1. Structure of the Single Equation Model

Each equation in the single equation model is of the general form:

$$Y_{it} = f(X_{jt}, u_t)$$

where: Y_{it} = the i-th endogenous variable in period t

X_{jt} = the j-th exogenous variable in period t

u_t = the error term in period t

Applying this form to both arms transfer variables yields 2 single equations

a. $ME_t = f(AI_t, GNP_t, CGE_t, PAF_t, u_t)$

b. $AI_t = f(ME_t, GNP_t, TI_t, PAF_t, u_t)$

where: ME_t = military expenditure in period t

AI_t = arms imports in period t

GNP_t = gross national product in period t

CGE_t = central government expenditure in period t

TI_t = total imports in period t

PAF_t = population of armed forces in period t

a. Military Expenditure Model

In this model, the changes in the dependent variable, military expenditure is affected by the changes of the independent variables, i.e., arms imports, gross national product, central government expenditure, population of armed forces and the error term, u.

b. Arms Import Model

Here, changes in arms imports, the dependent variable, are

affected by changes of the independent variables, i.e., military expenditure, gross national product, total imports, percentage of armed forces and the error term, u.

2. Structure of Simultaneous Equations Model

Each equation in the simultaneous model can be represented as in:

$$Y_{it} = f(Y_{jt}, X_{kt}, u_t)$$

where: Y_{it} = the i-th endogenous variable in period t

Y_{jt} = the j-th endogenous variable in period t

X_{kt} = the k-th exogenous variable in period t

u_t = error term in period t

A system of G equations can be shown as:

$$BY_t + CX_t = u_t$$

where: B is a nonsingular GxG matrix of coefficients of the endogenous variables.

Y_t is a vector of G endogenous variables in period t

C is a GxK matrix of coefficients of the exogenous variables

X_t is a vector of K exogenous variables in period t

u_t is a vector of G random error terms in period t, assumed to have zero means and a constant variance s

The addition of Y as an explanatory variable is the essence of simultaneity. Endogenous variables, such as variable j, are used to explain other endogenous variables such as i. Thus the analysis is concerned with the entire system of G equations rather than an individual one. [6]

The simultaneous equations for this arms transfers model exhibit the very close relationship between the endogenous variables ME and AI. Military expenditures are a constraint for arms imports, e.g., arms imports cannot exceed some proportion of military expenditures in a particular year. On the other hand, the amount of military expenditures in a particular year will be affected by the amount of arms imports in this particular year. For this arms transfer model, the simultaneous equations model turns out to be:

$$ME_t = f(AI_t, GNP_t, CGE_t, PAF_t, u_t)$$

$$AI_t = f(ME_t, GNP_t, TI_t, PAF_t, u_t)$$

or, it can be written as:

$$b11.ME + b12.AI + c11.GNP + c12.PAF + c13.CGE = u1$$

$$b21.ME + b12.AI + c21.GNP + c22.PAF + c24.TI = u2$$

or, in a matrix form:

$$\begin{bmatrix} b11 & b12 & c11 & c12 & c13 & 0 \\ b21 & b22 & c21 & c22 & 0 & c24 \end{bmatrix} X \begin{bmatrix} ME \\ AI \\ GNP \\ PAF \\ CGE \\ TI \end{bmatrix} = \begin{bmatrix} u1 \\ u2 \end{bmatrix}$$

where $B = \begin{bmatrix} b11 & b12 \\ b21 & b22 \end{bmatrix}$ $C = \begin{bmatrix} c11 & c12 & c13 & 0 \\ c21 & c22 & 0 & c24 \end{bmatrix}$ $u = \begin{bmatrix} u1 \\ u2 \end{bmatrix}$

$$A = (B,C) = \begin{bmatrix} b11 & b12 & c11 & c12 & c13 & 0 \\ b21 & b22 & c21 & c22 & 0 & c24 \end{bmatrix}$$

$$Y = \begin{bmatrix} ME \\ AI \end{bmatrix} \qquad X = \begin{bmatrix} GNP \\ PAF \\ CGE \\ TI \end{bmatrix}$$

IDENTIFICATION PROBLEM

Since the model above used simultaneous equations, it may happen that two or more equations consisting of the same variables cannot be distinguished from each other. This kind of problem is called the problem of identification.

A necessary condition for identifying any one of the equations in a simultaneous equation model is that every other equation in the system must contain at least one variable which is missing from the equation.

Let G be the total number of exogenous variables in the simultaneous equation system, K be the total number of exogenous or predetermined variables in the simultaneous equation system, g_1 be the number of endogenous variables, and k_1 be the number of exogenous variables in one of the equations. Also, let g_2 be the number of endogenous variables and k_2 be the number of exogenous variables not included in that equation. Thus:

$$g_2 = G - g_1 \text{ and } k_2 = K - k_1$$

The equation is exactly identified if $g_2 + k_2 = G - 1$ which means that the total number of variables excluded from the equation must equal the total number of endogenous variables in the simultaneous equation system less one.

If $g_2 + k_2 < G - 1$, the equation is underidentified, and if $g_2 + k_2 > G - 1$, the equation is overidentified. In the arms transfer model,

$$g_1 = 2 \text{ (ME and AI)} \Longrightarrow g_2 = G - g_1 = 0$$

$$k_1 = 3 \text{ (GNP, CGE and PAF)} \Longrightarrow k_2 = k - k_1 = 1 \text{ (TI)}$$

so, $g_2 + k_2 = 0 + 1 = G - 1 = 2 - 1$

that is the first equation is exactly identified.

Second equation (arms imports):

$g_1 = 2$ (ME and AI) ===> $g_2 = G - g_1 = 0$

$k_1 = 3$ (GNP,TI and PAF) ===> $k_2 = k - k_1 = 1$ (CGE)

so $g_2 + k_2 = 0 + 1 = G - 1 = 2 - 1 = 1$

Thus, the second equation is also exactly identified. So far the necessary condition is satisfied. [11] The identification problem requires both necessary and sufficient conditions.

As defined above, A is a Gx(G+K) matrix of all coefficients in the system and the rows are:

A1 = (b11 b12 c11 c12 c13 c14)

A2 = (b21 b22 c21 c22 c23 c24)

and Q is a (G+K)xG matrix of $\begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 1 \\ 1 & 0 \end{bmatrix}$

The restrictions on the equations can be expressed as

$A_1.Q_1 = 0$ and $A_2.Q_2 = 0$, i.e.

c14 = 0 and c23 = 0

Then the sufficient or rank condition for identification for this system is $\rho(A.Q) = G - 1$ where $\rho(A.Q)$ refers to the rank of the matrix A.Q. In the arms transfers model, G = 2, so that G - 1 = 1 and

$A.Q_1 = \begin{bmatrix} c14 \\ c24 \end{bmatrix} = \begin{bmatrix} 0 \\ c24 \end{bmatrix}$ and $A.Q_2 = \begin{bmatrix} c13 \\ c23 \end{bmatrix} = \begin{bmatrix} C13 \\ 0 \end{bmatrix}$

so $\rho(A.Q_1) = 1$ and $\rho(A.Q_2) = 1$

Since $G - 1 = 1$, $\rho(A.Q_1) = \rho(A.Q_2) = G - 1 = 1$, that satisfies the sufficient conditions for both first and second equations in the model. Since both necessary and sufficient conditions are satisfied, the equations in the arms transfers model are identified.

3. Sample and Data Collection

In modelling the arms transfer to the ASEAN countries (Indonesia, Malaysia, Philippines, Singapore and Thailand), the data for military expenditure (ME), arms imports (AI), gross national products (GNP), central government expenditures (CGE), population of the armed forces (PAF) and total imports (TI) are available for ten years in WORLD MILITARY EXPENDITURES AND ARMS TRANSFERS 1967-1976, where the data set with 1975 constant dollars has been picked for this analysis.

All the data except population of the armed forces are obtained in terms of local currencies. Approximate compensation for the effects of inflation was made by "deflating" the current local currency values to constant 1975 local currency values and then converting to 1975 US dollar equivalents.

The military expenditures data are the expenditures of the Ministry of Defense of each country.

The gross national product data represent the total output of goods and services produced by residents of each country and valued at the market prices ultimately paid by consumers. The source of the GNP data was the International Bank for Reconstruction and Development (IBRD).

The central government expenditures data include current and capital (developmental) expenditures plus net lending (gross government

lending minus repayments of past loans) but excludes the purchase of equities. The source of the data was US Statistical Yearbook 1976, OECD (Organization for Economic Cooperation and Development) Economic Surveys and individual country's Yearbook.

The population of Armed Forces refer to the active duty military personnel, including paramilitary forces where those forces resemble regular units in their organization, equipment, training or mission.

The arms imports data represent the international transfer under grant, credit or cash sale terms of military equipment, usually referred to as "conventional", including weapons of war, parts, ammunition, support equipment and other commodities considered primarily military in nature. Acquisition by a nation of some given quantity of armaments does not necessarily impose that burden on its economy; therefore, economic value of arms imports should not be related in detail to the local economies.

Total imports data cover both goods and services. These data come from the UN System of National Accounts as published in International Financial Statistics by International Monetary Fund.

All the data of each of the variables ME, AI, GNP, CGE, TI and PAF were pooled in eleven years for five countries and stored in a 55x6 matrix, as shown in Table III.1. [9]

4. Test of Pooling, Heteroscedasticity and Existence of Serial-Correlation

The available data must be tested to determine whether they can be pooled, whether there exists some heteroscedasticity, and whether there is any autocorrelation among the variables in applying the single

TABLE III.1. The data set of the econometric model of the arms transfers to the ASEAN countries (1967-1977). (PAF in millions people, others in millions $)

Country	ME	AI	PAF	GNP	CGE	TI
IND	491	3	0.367	19031	1807	1090
	639	8	0.347	20941	1873	1156
	720	15	0.358	22393	2147	1200
	787	29	0.357	24082	2711	1462
	888	28	0.358	25658	3580	1530
	940	27	0.356	27406	4357	2084
	872	25	0.309	30249	5285	3449
	916	46	0.27	31942	6061	4433
	1287	32	0.261	33794	7381	5025
	1260	80	0.257	36294	8557	5670
	1311	57	0.259	38653	8917	5905
MAL	205	14	0.042	5779	1656	1858
	200	16	0.046	6311	1633	1873
	190	31	0.046	6533	1402	1814
	221	7	0.058	6856	1603	2061
	237	42	0.062	7299	2010	2002
	409	40	0.069	8018	2483	2190
	357	51	0.07	8868	2204	3159
	416	35	0.075	9533	2623	4784
	477	53	0.076	9685	3052	3744
	440	40	0.08	10547	3096	3828
	474	57	0.079	11396	3785	4310
PHIL	113	40	0.045	10213	1120	1977
	120	32	0.051	11037	1146	2067
	127	31	0.055	11625	1447	1921
	133	15	0.059	12126	1408	1769
	140	28	0.058	12826	1274	1850
	198	40	0.062	13457	1957	1830
	249	25	0.063	14755	2131	2236
	305	35	0.09	15690	1839	4004
	515	42	0.12	16616	2644	3942
	553	60	0.14	17734	2773	3938
	597	57	0.155	18814	3019	4045
SING	54	0	0.01	2588	450	2364
	77	0	0.011	2762	452	2050
	187	15	0.012	3130	481	3136
	309	29	0.014	3535	634	3596
	308	28	0.015	3932	843	3949
	319	80	0.02	4423	933	4541
	325	63	0.024	4802	1117	6507
	329	35	0.024	5516	1068	9674
	324	21	0.028	5451	1305	8565
	381	20	0.035	5782	1372	9070
	401	28	0.036	6221	1431	9925

TABLE III.1 (Continued)

Country	ME	AI	PAF	GNP	CGE	TI
THAI	131	94	0.152	8794	1492	1490
	148	113	0.167	9324	1761	1873
	185	77	0.175	10056	1808	1921
	224	44	0.175	10735	1961	1900
	299	56	0.195	11574	2277	1794
	311	40	0.205	12048	2224	1977
	292	126	0.233	13280	2136	2590
	319	46	0.221	14030	1892	3625
	380	42	0.227	15057	2359	3455
	478	80	0.228	16245	2801	3572
	615	47	0.23	17227	3148	4375

equation model. Therefore, the three tests which must be completed prior to solving the problem are

a. The Chow test for pooling

In this test, two alternatives were used:

- each two years observation for all countries.

- the whole observations, i.e., pooled sample.

Therefore, there were five tests in each single equation or ten test results for both ME and AI.

The procedures for testing both samples are:

(1) Calculate sum of squared errors on both samples: ESS1 for the first sample and ESS2 for the second sample, as the outcomes of the single equations, using the ordinary least square (OLS).

(2) Calculate the value of

$$F = \frac{(ESS2-ESS1)/(N+T-2)}{(ESS1)/(NT-N-T)}$$

(3) Get the F (a,b) using F-distribution table.

Where a is (N+T-2) and b is (NT-N-T).

(4) The null hypothesis that the sample size can be pooled can be accepted if the F-value in $2 < F(a,b)$.

The result for the military expenditures and arms imports data turned out to be:

- ME equation:

(a) ESS of five two years observations were:

89331.75/80494.19/147188.04/120839.15/116455.08

(b) ESS of pooled sample were:

75018.05

(c) F (5,40), with .026 significancelevel = 2.90

(d) F-values yield from (a) and (b) were:

.934/1.051/.518/.658/.688

(e) Since all F-values in (d) were less than 2.90, so the null hypothesis can be accepted for all groups.

There is therefore no problem in pooling the data for the military expenditure equation.

- AI equation:

(a) ESS of five two years observations were:

4082.07/1865.15/1650.24/2017.38/1595.54

(b) ESS of pooled sample were:

27418.06

(c) F (5,40), with .025 significancelevel = 2.90

(d) F-values yield from (a) and (b) were:

.715/1.713/1.952/1.574/2.023

(e) Since all F-values in (d) less than F (5,40) = 2.90, the null hypothesis can be accepted. In other words, there is no problem in pooling for the arms imports equation.

With the results on the Chow test on both single equations ME and AI above, there is no problem in pooling the data, i.e., pooling of the data is feasible so the analysis may proceed to the next step in estimation.

b. The Goldfelt-Quandt Test for Heteroscedasticity

This test involves the calculation of two least-squares regression lines, one using data thought to be associated with low variance errors and the other using data thought to be associated with high

variance errors. If the residual variances associated each regression line are approximately equal, the null hypothesis of homoscedasticity cannot be rejected. On the contrary, if residual variances increase substantially, the null hypothesis of homoscedasticity can be rejected.

The Goldfelt-Quandt test can be carried out as follows:

(1) Order the data by the magnitude of the independent causative variable X, which is thought to be related to the error variance.

(2) Omit the middle "d" observations where "d" is to be approximately one-fifth of the total sample in this case. In general, "d" is selected based upon considerations of power.

(3) Fit two separate regressions, the first for the low values of X and the second for the high values of X.

(4) Calculate the residual sum of squares associated with each regression, ESS1 associated with low X's and ESS2 associated with high X's.

(5) Assuming that the error process is normally distributed and no serial correlation is present, the statistic ESS2/ESS1 will be distributed as an F statistic with (N-d-4)/2 degrees of freedom in both numerator and denumerator.

(6) The null hypothesis of homoscedasticity can be accepted if ESS2/ESS1 is less than the critical value of the F distribution with (N-d-4)/2 on both numerator and denumerator.

Applying this procedure to the ME (military expenditures) with causative variables GNP, CGE, PAF and to the AI (arms imports) with causative variables GNP, TI, PAF using APL programs yield:

ME/GNP ===> (ESS2/ESS1) = 1.322

ME/PAF ===> (ESS1/ESS1) = .394

ME/CGE ===> (ESS2/ESS1) = 1.233

AI/GNP ===> (ESS2/ESS1) = 2.126

AI/PAF ===> (ESS2/ESS1) = .704

AI/TI ===> (ESS2/ESS1) = .706

F (18,18) with significance level .05 = 2.33

Since the values of (ESS2/ESS1) are less than the critical value of F (18,18) distribution with significance level .05, the hypothesis that the error terms are homoscedastic can be accepted.

c. The Durbin-Watson test for serial correlation

Consider a test of the null hypothesis that no serial correlation is present ($\rho = 0$). This test involves the calculation of a statistic based on the residuals from the ordinary least squares regression procedure. The statistic is defined as follows:

$$DW = \frac{\left(\sum_{t=1}^{T} e_t - e_{t-1}\right)^2}{\sum_{t=1}^{T} e_t^2}$$

The Durbin Watson statistic will lie in the range (0,4), in which values near two indicate no first order serial correlation. Exact interpretation of the DW statistic is difficult because the sequence of error terms depends not only on the sequence of e's, but also on the sequence of all X values. Two limits are given, labelled dL for lower limit and dU for upper limit.

The range of the Durbin Watson statistics can be figured as shown in Table III.2.

Table III.2. The range of Durbin-Watson statistics.

Value of DW	Result
(4-dL) < DW < 4	Reject Ho (negative serial correl.)
(d-dU) < DW < (4-dL)	Indeterminate result
2 < DW < (4-dU)	Accept Ho
dU < DW < 2	Accept Ho
dL < DW < dU	Indeterminate result
0 < DW < dL	Reject Ho (positive serial correl.)

The result of running regressions using OLS (ordinary least squares) for each individual country in ten years observations for the Durbin-Watson statistic are shown in Table III.3.

Table III.3. The Durbin-Watson statistics of the OLS to the individual ASEAN countries.

	ME	AI
Indonesia	DW = 1.7281	DW = 2.1845
Malaysia	DW = 2.2866	DW = 2.9486
Philippines	DW = 1.9834	DW = 2.2992
Singapore	DW = 1.2560	DW = 1.6480
Thailand	DW = 2.3798	DW = 2.0718

The plots of residuals for both equations for each country showed that there was no serial correlation behavior in this estimation. These are shown in Figures III.1 and III.2.

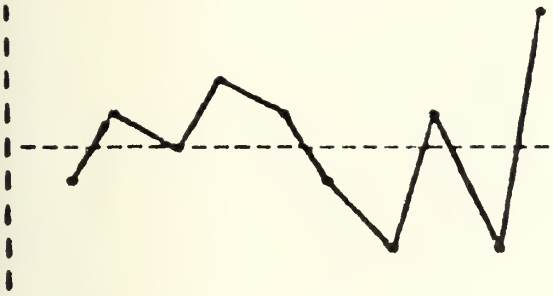
With the above results, it can be determined that there is no serial correlation present in the error terms.

5. Results of Final Estimation for Single Equation Model

Using the OLS program in TSP (Time Series Processor) to estimate the single equation model for military expenditures and arms imports for each individual country in ten years observations yields the results which are shown in Table III.4 and Table III.5. The results will be discussed more fully in Chapter IV.

6. Results of Estimation for Simultaneous Equation Model

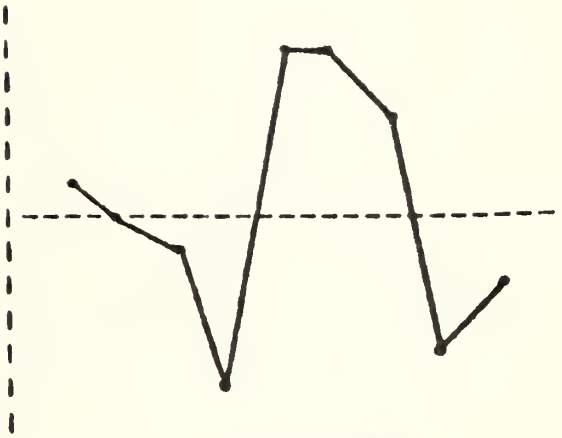
The FIML (full information maximum likelihood) program in TSP (time series processor) was used to estimate the simultaneous equations model for military expenditure and arms imports. The empirical results are shown in Table III.6 and the results will be discussed more fully in Chapter IV.



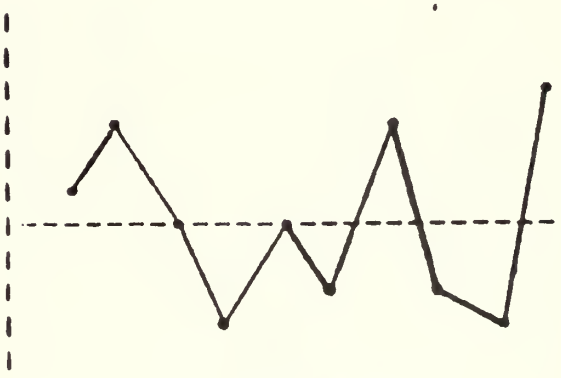
INDONESIA

MALAYSIA

PHILIPPINE



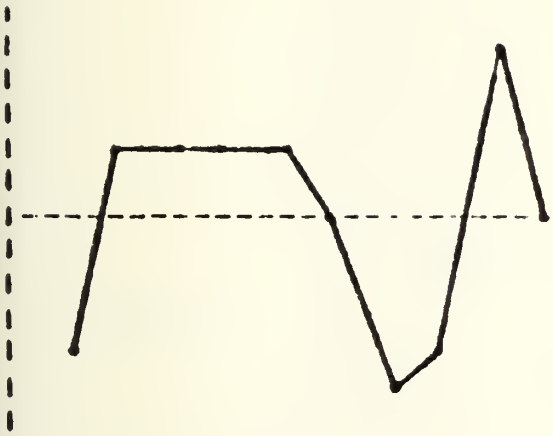
SINGAPORE



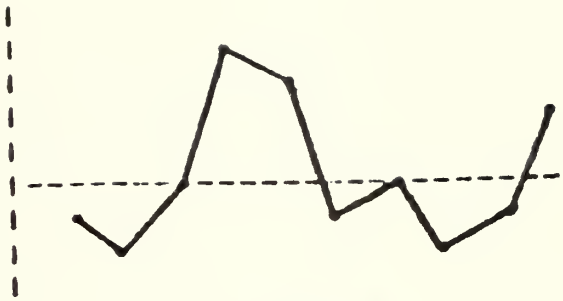
THAILAND

FIGURE III.1

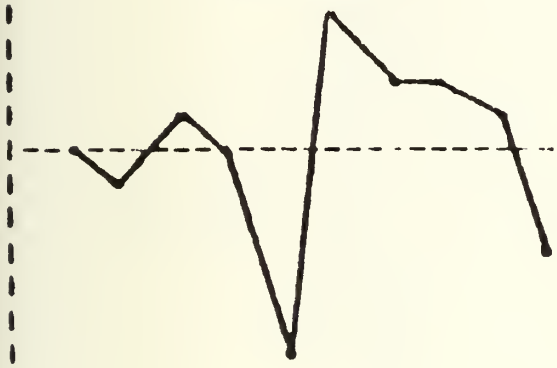
The plots of residuals of OLS on military expenditures of the individual ASEAN countries



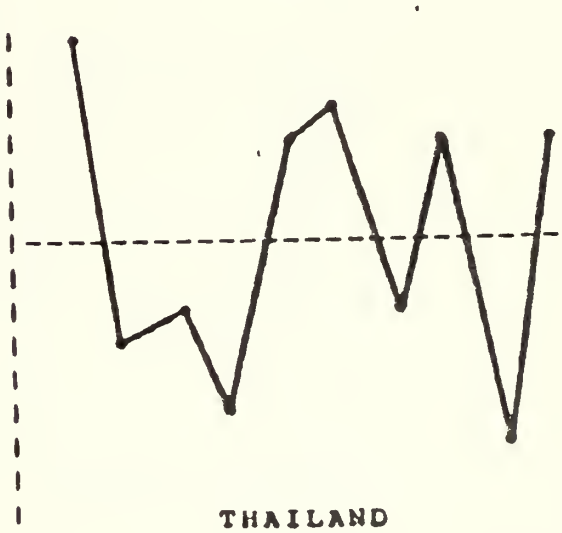
INDONESIA



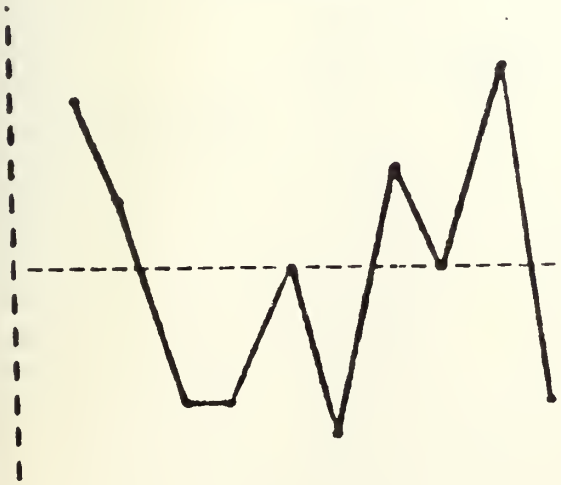
SINGAPORE



MALAYSIA



THAILAND



PHILIPPINE

FIGURE III.2

The plots of residuals of OLS on arms imports of the individual ASEAN countries

Table III.4. The results of OLS on military expenditures of the individual ASEAN countries.

Country	R/H Variable	Estimated Coefficient	t-Statistics
INDONESIA	a_0(C)	-793.59	-.69
	a_1(GNP)	.026	.71
	a_2(CGE)	.076	.89
	a_3(PAF)	1992.53	-.27
	a_4(AI)	-.937	.65
	(SSR = 62887.2	SER = 112.149	DW stat = 1.7281)
MALAYSIA	a_0(C)	-100.423	-1.36
	a_1(GNP)	-.001	.035
	a_2(CGE)	.138	2.373
	a_3(PAF)	1785.4	.56
	a_4(AI)	.41	.36
	(SSR = 6887.5	SER = 37.115	DW stat = 2.2866)
PHILIPPINE	a_0(C)	-170.223	-1.58
	a_1(GNP)	-.002	-.14
	a_2(CGE)	.093	2.05
	a_3(PAF)	3541.07	3.86
	a_4(AI)	.035	.295
	(SSR = 3618.86	SER = 26.9	DW stat = 1.9834)
SINGAPORE	a_0(C)	-242.67	-1.42
	a_1(GNP)	.19	1.63
	a_2(CGE)	-.19	-.52
	a_3(PAF)	-7761	-.78
	a_4(AI)	.97	1.06
	(SSR = 16443.4	SER = 57.347	DW stat = 1.256)

Table III.4 (Continued)

Country	R/H Variable	Estimated Coefficient	t-Statistics
THAILAND	a_0(C)	-252.71	-5.49
	a_1(GNP)	.027	3.78
	a_2(CGE)	.12	5.02
	a_3(PAF)	-139.78	-.27
	a_4(AI)	-.28	-1.69
	(SSR = 1019.43	SER = 14.279	DW stat = 2.3798)

Table III.5. The results of OLS on arms imports of the individual ASEAN countries.

Country	R/H Variable	Estimated Coefficient	t-Statistics
INDONESIA	b_0(C)	-156.02	-.735
	b_1(ME)	-.006	-.10
	b_2(TI)	.007	.32
	b_3(PAF)	258.15	.44
	b_4(GNP)	.003	.69
	(SSR = 1076.77	SER = 14.675	DW stat = 2.1845)
MALAYSIA	b_0(C)	-28	-.793
	b_1(ME)	.053	.485
	b_2(TI)	-.008	-.873
	b_3(PAF)	-109.5	-.088
	b_4(GNP)	.009	.693
	(SSR = 507.837	SER = 10.078	DW stat = 2.2992)
PHILIPPINE	b_0(C)	60.887	1.48
	b_1(ME)	.074	.62
	b_2(TI)	-.001	-.007
	b_3(PAF)	207.79	.36
	b_4(GNP)	-.004	-1.16
	(SSR = 884.672	SER = 13.3017	DW stat = 2.9486)
SINGAPORE	b_0(C)	-95.97	-1.07
	b_1(ME)	.03	.15
	b_2(TI)	-.012	-1.23
	b_3(PAF)	-3535.16	-.83
	b_4(GNP)	.06	1.05
	(SSR = 2496.15	SER = 22.34	DW stat = 1.648)

Table III.5 (Continued)

Country	R/H Variable	Estimated Coefficient	t-Statistics
THAILAND	b_0(C)	-105.96	-.44
	b_1(ME)	-.716	-.73
	b_2(TI)	-.04	-.48
	b_3(PAF)	93.23	.05
	b_4(GNP)	.037	.47
	(SSR = 6382.79	SER = 35.73	DW stat = 2.0718)

Table III.6. The results of the simultaneous equation model of the arms transfer to the ASEAN countries.

RH Variable	Estimated Coefficient	Standard Errors	t-Statistics
a_0(C)	-996.13	227.52	-4.38
a_1(GNP)	.01	.02	.5
a_2(CGE)	.019	.01	1.83
a_3(PAF)	-133.76	148.67	-.9
a_4(AI)	31.84	1.17	27.16
b_0(C)	29.2	6.85	4.27
b_1(ME)	-.02	.021	-1.11
b_2(TI)	.002	.009	2.2
b_3(PAF)	6.07	4.54	1.34
b_4(GNP)	.001	.001	.84

(ME: SSR = 319204 SER = 799.004 DW stat = 1.3886)

(AI: SSR = 27959.6 SER = 23.6772 DW stat = 1.5298)

B. FORECASTING MODEL

The econometric model which is explored above, is concerned more with the structure of the model, based upon the historical data of two endogenous variables, military expenditures and arms imports, and four exogenous variables, gross national product, central government expenditures, total imports and population of armed forces, in nine years and five countries observations.

This section will explore the forecasting model, which will adjust the structural model to give a better result, closer to the expected estimation.

A forecast is a quantitative estimate about future events based on past and current informations. By extrapolating the models out beyond the period over which they were estimated, the information contained in them can be used to make forecasts about future events. The prediction problem here is to obtain estimates or guesses as to the movement of military expenditures and arms imports variables, given additional information about the movement of lags of gross national product, central government expenditures, total imports and population of armed forces, i.e., lagged variables LGNP, LCGE, LTI and LPAF.

Next, unconditional ex-post forecasts, unconditional ex-ante and conditional ex-ante forecasts will be discussed. The ex-post forecast applies when the forecast period is such that the observations on both endogenous variables are known with certainty. The ex-ante forecast predicts values of the dependent variable beyond the estimation period using explanatory variables which may or may not be known with certainty, depending on the nature of the data and the length of the lags associated with the explanatory variables. In the unconditional

forecast, values for all the explanatory variables in the forecasting equation are known with certainty. In the conditional forecast, values for one or more explanatory variables are not known with certainty, so that forecast for them must be used to produce the forecast of the dependent variable.

The result generated from the ex-post forecast can be checked against the existing data, providing a means of evaluating the forecast model. The ex-ante/unconditional forecast, uses the current (1977) values of ME and AI and lags (1976) values of ME. AI, GNP, CGE, TI, PAF to get the forecast values of ME and AI for the current year (1977).

1. Structure of the Model

The structure of the model is not far from the simultaneous equations model described in the previous section A modification using the lagged variables is needed to obtain both ex-post and ex-ante forecasts.

The military expenditure and arms imports equations were simultaneously regressed using FIML with the following structure:

$$ME_t = f(ME_{t-1}, AI_{t-1}, GNP_{t-1}, CGE_{t-1}, PAF_{t-1})$$

$$AI_t = f(ME_{t-1}, AI_{t-1}, GNP_{t-1}, TI_{t-1}, PAF_{t-1})$$

Figure III.3 is the block diagram of the forecasting model.

Nine years observations for both lagged (1967-1975) and current (1968-1976) variables will be applied to this forecasting model. The data in 1977 is kept out for testing the accuracy of the model, especially for the ex-ante forecast.

2. Forecasting Accuracy Test

Various errors must be taken into account in any study of the accuracy of econometric forecasts, such as:

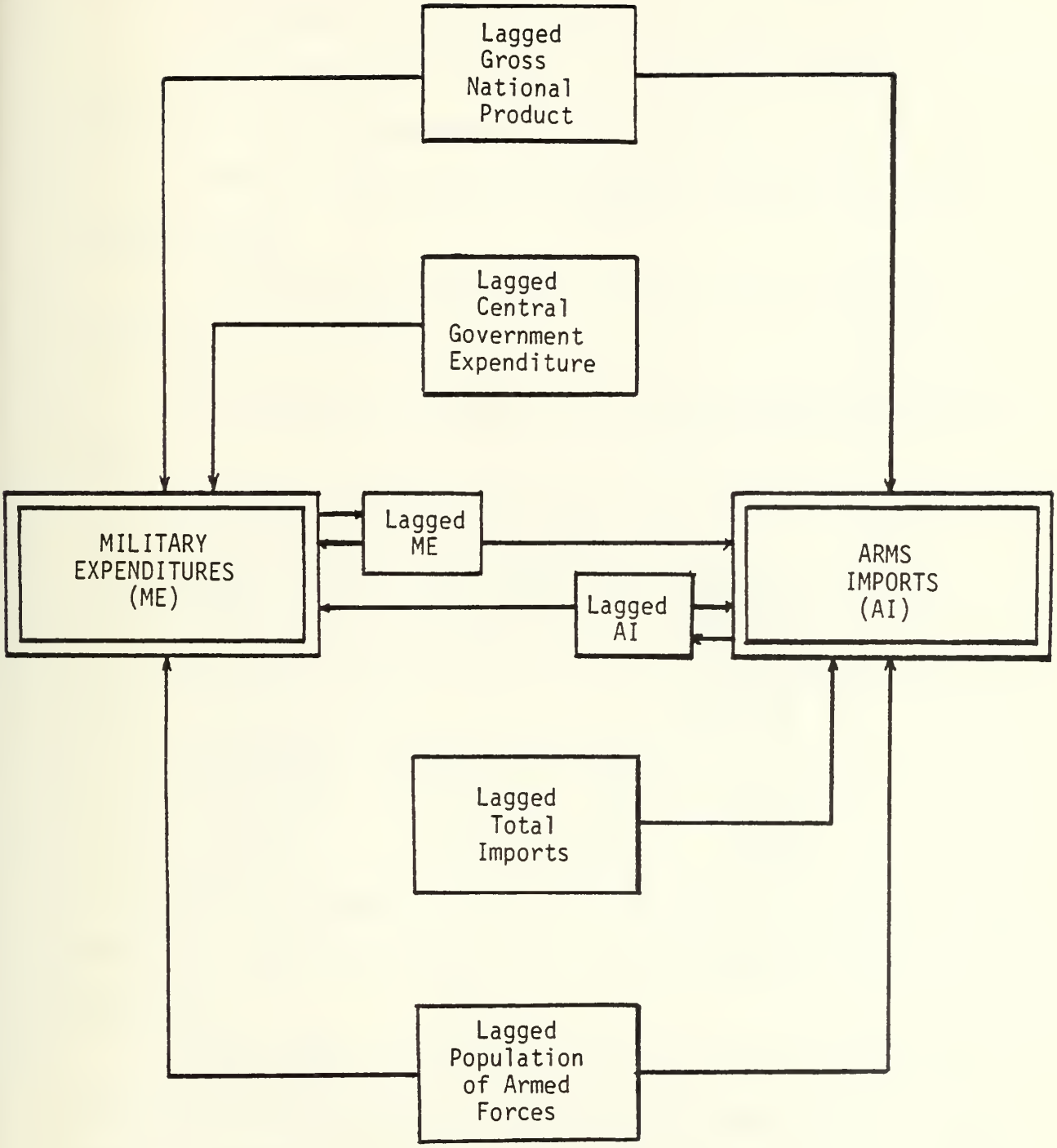


FIGURE III.3

The block diagram of
the arms transfers forecasting model

- Inaccuracy in the model related to simplification of reality and hence the model may omit certain influences and simplify others.

- Inaccuracy of the data used in the estimation of the model.

- Inaccuracy or bias present in the method of estimation, to which must be added possible errors of computation (round-off error).

- Errors in the forecasts of exogenous variables and in the constant factors.

- Inaccuracies in the "actual" data to which the forecast is to be compared.

The structure of the model in 1. can be rewritten in a matrix form:

$$Y_t = \Pi_1 Y_{t-1} + \Pi_2 X_{t-1} + \Pi_0 + U_t$$

where: $Y_t = ME_t$ $Y_{t-1} = ME_{t-1}$ $X_{t-1} = \begin{bmatrix} GNP_{t-1} \\ CGE_{t-1} \\ TI_{t-1} \\ PAF_{t-1} \end{bmatrix}$ $U_t = U_t$

$$\Pi_1 = \begin{bmatrix} 0 & a_1 \\ b_1 & 0 \end{bmatrix} \qquad \Pi_2 = \begin{bmatrix} a_2 & a_3 & 0 & a_4 \\ b_2 & 0 & b_3 & b_4 \end{bmatrix} \qquad \Pi_0 = \begin{bmatrix} a_0 \\ b_0 \end{bmatrix}$$

A convenient way of showing geometrically the accuracy of forecasts in the case of the forecast of a single variable is given in Figure III.4.

In this figure, the 45 degree line is the line of perfect forecasts, for which the actual and forecasted percentage changes are equal. Quadrant I contains points for which an increase was forecasted and for which an increase actually occurred. Quadrant III contains points for which a decrease was forecasted and for which a decrease actually

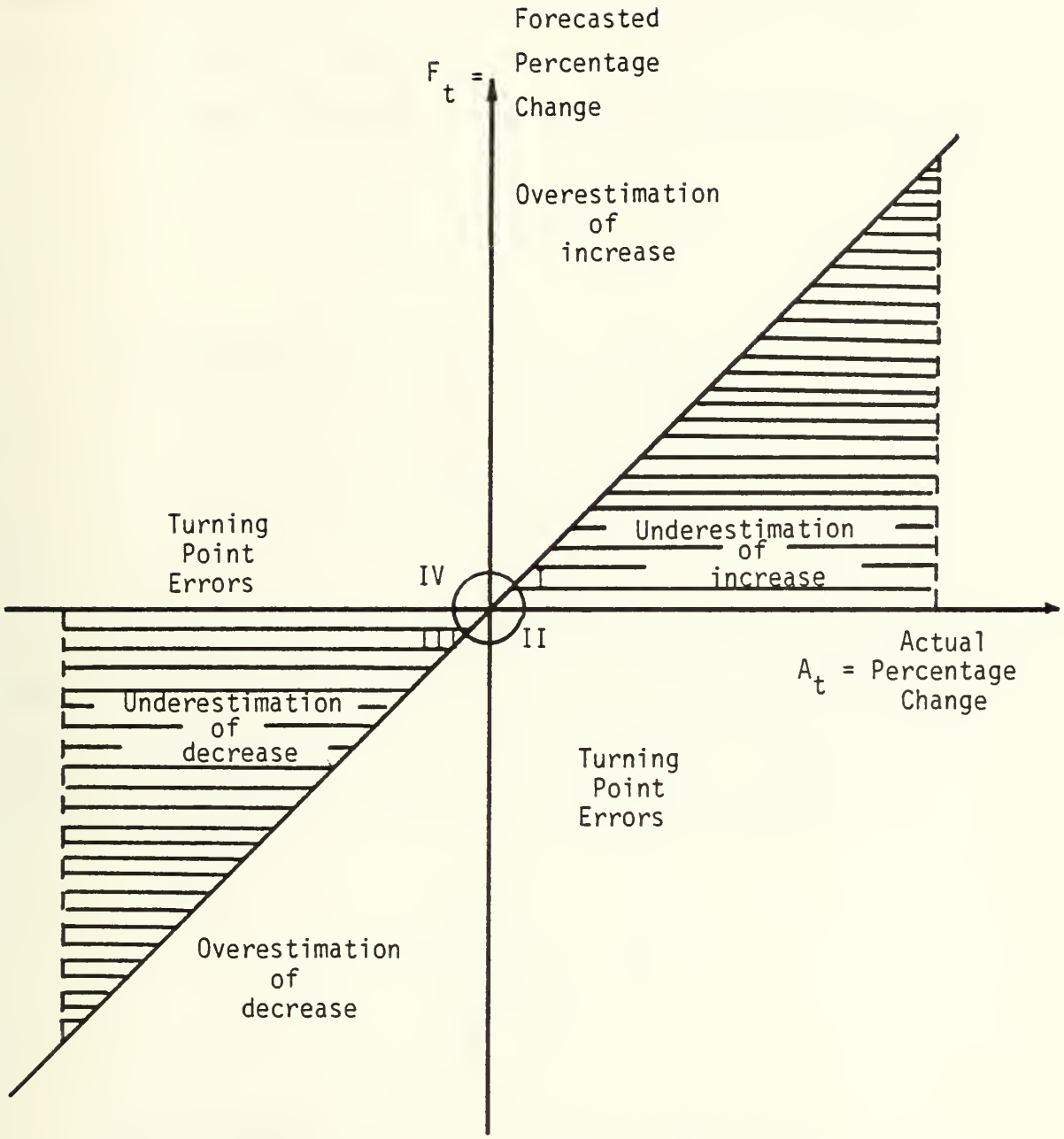


FIGURE III.4

Forecasted vs. Actual
Percentage of Change

occurred. Quadrant II contains turning point errors for which an increase was forecasted but the variable actually decreased. Quadrant IV contains turning point errors, for which a decrease was forecasted but the variable actually increased.

The actual percentage change, shown on the horizontal axis is:

$$A_t = \left(\frac{Y_t - Y_{t-1}}{Y_{t-1}}\right) \times 100$$

and forecasted percentage change, shown on the vertical axis, is:

$$F_t = \left(\frac{Y_t - Y_{t-1}}{Y_{t-1}}\right) \times 100$$

An algebraic measure of the overall accuracy of several forecasts is the inequality coefficient. If F_t and A_t are forecast and actual percent changes respectively, for period i, ranging from 1 to m, then the inequality coefficient for this set of forecasts is:

$$U_t = \frac{\sqrt{\frac{1}{m}\sum_{i=1}^{m}(A_{ti} - F_{ti})^2}}{\sqrt{\frac{1}{m}\sum_{i=1}^{m} A_{ti}^2}}$$

Here the numerator is the root mean square error in the forecast, while the denominator is the root mean square error assuming zero forecasted change. The case of perfect forecasts is that which $U_t = 0$. If $F_t = 0$, so the forecasted percent change were zero, meaning a status quo forecast for all variables in question, then $U_t = 1$. The case of

U_t = 1 is therefore equivalent to a status quo forecast. U_t can exceed unit, in which case the forecasts are worse than the status quo forecast. [8]

3. Empirical Results

Applying the data, in which the AI data for Singapore in 1967 and 1968 were changed to nonzero numbers to avoid overflow in the program processing, and using the same procedure as in the simultaneous econometric model, with the FIML program in the TSP, the results are shown in Table III.7.

Table III.7. The empirical results of the forecasting model of the arms transfers to the ASEAN countries.

RH Vars.	Estimated Coefficient	Standard Errors	t-Statistics
a_0(C)	25.6861	25.0593	.985679
a_1(LME)	.8811	.0931	9.4601
a_2(LAI)	-.2558	.445	-.57484
a_3(GNP)	.0062	.0041	1.51525
a_4(CGE)	.0003	.0204	-.01515
a_5(PAF)	-15.7499	185.813	-.08476
b_0(C)	19.6392	10.1993	1.9255
b_1(LME)	.0205	.0289	.7093
b_2(LAI)	.5092	.1294	3.92339
b_3(TI)	-.0006	.0024	-.25188
b_4(GNP)	-.00025	.001	-.24613
b_5(PAF)	-6.7804	55.5841	-.12199
(ME: SSR = 209778	SER = 68.2769	DW Stat = 2.1649)	
(AI: SSR = 21039.1	SER = 21.6225	DW Stat = 2.5125)	

The forecasting accuracy check was done for the nine years observations of the five countries, using the empirical result above. The predicted values of 1968-1976 and the actual values of the same years were applied to the A_t, F_t, and U formula which were described in Section 2. This yielded inequality coefficients (U_t) for ME = 0.849 and AI = 12.278 respectively. The large number of AI, 12.378, is not surprising, since the data in 1967 and 1968 of Singapore predicted this large result. When the small non-zero numbers were changed to numbers closer to the predicted values in those specific years, the inequality coefficient dropped drastically. For example, when the actual AI of Singapore in 1967 and 1968 were changed to 18.83 and 19.13, which were the closest numbers to the predicted values, the inequality coefficient dropped to 1.0009.

To check the forecasting accuracy of the predicted values in 1977, using the 1976 data for five countries, Table III.8 was constructed.

Table III.8. Steps and results of the accuracy test of the individual countries forecasting model.

	IND	MAL	PHIL	SIN	THAI	COMBINED
ME'76(A)	1260	440	553	381	478	
AI'76(A)	80	40	60	20	60	
ME'77(A)	1311	474	597	401	615	
ME'77(F)	1346.5	487.9	365.2	337.3	435.4	
AI'77(A)	57	57	57	28	47	
AI'77(F)	48.5	51	44	30.1	41.3	
AT(ME)	.04	.08	.08	.05	.29	
AT(AI)	-.29	.43	-.05	.4	-.41	
FT(ME)	.07	.11	.02	-.011	-.09	
FT(AI)	-.33	.28	-.27	.5	-.48	
UT(ME)	.7	.41	.72	3.1	1.31	1.33
UT(AI)	.37	.35	4.3	.27	.17	.4

IV. ANALYSIS OF THE RESULTS

To get a better analysis of the empirical results from Chapter Three, this chapter is divided into two parts. The first part is the analysis of the results from the individual countries of the ASEAN and the second one is the analysis of the result from the ASEAN countries as a whole.

A. ON INDIVIDUAL COUNTRIES

In Chapter Two it was shown that even though the five ASEAN countries have something in common, the differences among them are a significant factor which affects the empirical results for both the econometric and forecasting model, described in Chapter Three. It was necessary to analyze the individual results of each ASEAN country so that the different behaviors and conditions can be traced and distinguished in order to explain their effects on the models as a whole. Since for these individual country data, the sample size requirement for the simultaneous equation model was hardly satisfied, the OLS procedure is necessary to distinguish the significant differences between and among the ASEAN countries.

It is interesting that negative signs are found in some of the right hand variables on both military and arms imports equations in both econometric and forecasting models. Since only a few of the t-statistics of these specific estimated coefficients are significant, and since FIML is preferable to OLS estimation, these negative signs are not significant enough to be considered in the process of finding the structure of the model.

1. Indonesia

a. Econometric Model

- Military expenditure equation:

$$ME = -793.59 + .026GNP + .076CGE + 1992.5PAF - .937AI$$
$$(-.69)\quad (.71)\quad (.89)\quad (-.27)\quad (.65)$$

(SSR = 62887.2 SER = 112.149 DW Stat = 1.7281)

- Arms imports equation:

$$AI = -156.02 - .006ME + .007TI + 258.15PAF + .003GNP$$
$$(-.74)\quad (.1)\quad (.32)\quad (.44)\quad (.69)$$

(SSR = 107.77 SER = 14.695 DW Stat = 2.1845)

b. Forecasting Model

- Military expenditure equation:

$$ME = 2272.92 + .35LME + 11.8LAI -$$
$$(5.8)\quad (2.6)\quad (5.75)$$

$$.042LGNP + .525LCGE - 3042PAF$$
$$(-2.21)\quad (1.16)\quad (-4.4)$$

(SSR = 3349.48 SER = 33.414 DW Stat = 3.686)

- Arms imports equation:

$$AI = 19.89 + .08LME - .07LAI -$$
$$(.12)\quad (1.88)\quad -1.07)$$

$$.0004LGNP + .0007LCGE - 162.27PAF$$
$$(-.017)\quad (.127)\quad (-.32)$$

(SSR = 328.954 SER = 10.47 DW Stat = 2.341)

In both ME and AI equations, the forecasting model showed better results than the econometric model, even though the DW statistic in the forecasting model showed the existence of a small extent of the negative serial correlation, the results of the SSR, SER and the t-statistics in the forecasting model have better values than in the econometric model, for both military expenditure and arms imports

equation. Some factors of Indonesian behavior related to the arms transfer model might be considered in the analysis of the results. The population of the armed forces has been decreasing since 1970. Military expenditure jumped in 1975, and this was related to the East Timor dispute. Consequently, arms imports jumped in 1976 to purchase the necessary weapons in conjunction with the continuing East Timor dispute. The decrease of armed forces population and the increase of military expenditures and arms imports indicated that for Indonesia this decade was more concentrated in building up the quality not the quantity of manpower and in purchasing more hardware weapons in modernizing its military.

2. Malaysia

a. Econometric model

- Military expenditure equation:

$$ME = \underset{(1.36)}{-100.42} - \underset{(.035)}{.001GNP} + \underset{(2.37)}{.138CGE} + \underset{(.56)}{1785.4PAF} + \underset{(.36)}{.41AI}$$

(SSR = 6886.5 SER = 37.115 DW Stat = 2.2866)

- Arms imports equation:

$$AI = \underset{(.735)}{-156.02} - \underset{(-.1)}{.036ME} + \underset{(.32)}{.007TI} + \underset{(.44)}{258.15PAF} + \underset{(.69)}{.003GNP}$$

(SSR = 1076.77 SER = 14.675 DW Stat = 2.1843)

b. Forecasting model

- Military expenditure equation:

$$ME = \underset{(-1.96)}{-297.46} - \underset{(-1.55)}{.99LME} + \underset{(1.14)}{1.63LAI} +$$

$$\underset{(.73)}{.031LGNP} + \underset{(1.24)}{.142LCGE} + \underset{(1.44)}{5403.04LPAF}$$

(SSR = 5249.62 SER = 41.83 DW Stat = 2.4626)

- Arms imports equation:

$$AI = \underset{(.255)}{13.57} + \underset{(.513)}{.037LME} - \underset{(-.72)}{.298LAI} +$$

$$\underset{(.522)}{.006LGNP} - \underset{(-1.03)}{.0198LTI} + \underset{(2.56)}{2526.9LPAF}$$

(SSR = 187.727 SER = 7.9105 DW Stat = 2.8321)

Negative serial correlations exist to a small extent in the forecasting model, as it is shown in the DW statistics, but the other indicators (SSR, SER and t-statistics) indicate a better result for the forecasting model of the military expenditures and arms imports in Malaysia. In analyzing the result, some factors in the Malaysian data sets should be considered.

The arms imports were fluctuating in nine years observations (1968-1976). 1970 was the year when the smallest amount of arms imports occurred. The population of armed forces showed an increasing trend, especially in 1970 when it experienced a big increase. This explains why arms imports in that year was small, while military expenditure was still increasing in 1970. The military expenditure was concentrated to build up the manpower rather than purchasing hardware weapons. On the contrary, in 1973, while military expenditure was decreased slightly, the population of armed forces decreased more and arms imports jumped. This indicates that during that year, military expenditure was more concentrated in purchasing the hardware weapons rather than in building up the manpower. All the GNP, CGE and TI variables have shown an increasing trend.

3. Philippines

a. Econometric Model

- Military expenditure equation:

ME = -170.2 - .002GNP + .093CGE + 3541.07PAF + .035AI
(-1.58) (-.14) (2.05) (3.86) (.293)

(SSR = 3618.86 SER = 26.9 DW Stat = 1.9834)

- Arms imports equation:

AI = 60.89 + .074ME - .0001TI + 207.79PAF - .004GNP
(1.48) (.62) (-.007) (.36) (-1.16)

(SSR = 884.672 SER = 13.302 DW Stat = 2.9486)

b. Forecasting Model

- Military expenditure equation:

ME = -668.07 + .508LME + 3.25LAI +
(-3.17) (.68) (1.68)

.072LGNP - .151LCGE + 380.2LPAF
(3.89) (-1.67) (.12)

(SSR = 4049.35 SER = 36.739 DW Stat = 2.229)

- Arms imports equation:

AI = 39.254 + .103LME - .189LAI +
(.604) (.625) (-.303)

.0043LGNP - .002LTI - -94.18LPAF
(.391) (.386) (-.104)

(SSR = 374.944 SER = 11.1795 DW Stat = 2.315)

For the Philippines, the econometric model was better than the forecasting model for the military expenditure equation, but the reverse was true for the arms imports equation. SSR, SER and t-statistics for the military expenditures in the econometric model were better than in the forecasting model, but for the arms imports equation the reverse was true. The DW statistics in arms imports estimation indicated the presence of negative serial correlation to a small extent. Analysis of the actual data is done below to trace the factors that affect the empirical result.

The arms imports in 1968-1976 were fluctuating. They dropped in 1970, jumped in 1972, dropped again in 1973 and jumped again in 1975. The military expenditures were always increasing and it experienced a jump in 1975. All of the other variables, GNP, CGE, TI and PAF had increasing trends.

The results in the accuracy test which was performed in Chapter III for the Philippines indicated that it was hard to predict the arms imports values (inequality coefficient U = 4.3). The DW statistic for the arms imports estimation indicated that there exists some negative serial correlation in the errors.

The Philippines have no real threat from outside yet, but the Muslim rebellion and the existence of martial law affect the behavior of military expenditures and arms imports.

4. Singapore

a. Econometric Model

- Military expenditure equation:

$$ME = \underset{(-1.42)}{-242.67} + \underset{(1.63)}{.19GNP} - \underset{(-.52)}{.19CGE} - \underset{(-.78)}{.7761PAF} + \underset{(1.06)}{.97AI}$$

(SSR = 16443.4 SER = 57.347 DW Stat = 1.2560)

- Arms imports equation:

$$AI = \underset{(-1.07)}{-95.9} + \underset{(.15)}{.03ME} - \underset{(-1.23)}{.012TI} - \underset{(-.83)}{3535.2PAF} + \underset{(1.05)}{.06GNP}$$

(SSR = 2496.15 SER = 22.34 DW Stat = 1.648)

b. Forecasting Model

- Military expenditure equation:

$$ME = \underset{(.174)}{-65.09} + \underset{(.72)}{.599LME} - \underset{(-.27)}{.372LAI} + \underset{(.39)}{.126LGNP} - \underset{(-.52)}{.202LCGE} - \underset{(-.17)}{7042.6LPAF}$$

(SSR = 278.866 SER = 9.64 DW Stat = 2.2208)

- Arms imports equation:

AI = -215.34 - .269LME + .59LAI -
(3.58) (-1.99) (2.12)

.01LGNP + .198LTI - 24730.7LPAF
(-2.01) (3.88) (-3.68)

(SSR = 278.866 SER = 9.64 DW Stat = 3.3898)

The arms imports estimate for the forecasting equation shows a better result than in econometric model, but this was reversed when estimating military expenditures. The DW statistic in both equations in the econometric model indicated a small extent of positive serial correlation, while in the forecasting model the DW statistic indicated a small extent of negative serial correlation in the errors. The results of SSR, SER and t-statistics in the forecasting model for the military expenditure equations were better than in the econometric model, but they were better in the econometric model for the arms imports equations. Analysis of the actual data will explain some factors that might affect this estimation.

Military expenditures and arms imports in 1968 were small, almost zero for arms imports, since Singapore was a new and small nation at that time. Since then, Singapore's government always related purchasing arms to the movements of their GNP, CGE and PAF. They took a good opportunity in obtaining the surplus arms during and after the Vietnam war.

5. Thailand

a. Econometric Model

- Military expenditure equation.

ME = 252.71 + .027GNP + .12CGE - 139.78PAF - .28AI
(-5.49) (3.78) (5.02) (-.27) (-1.69)

(SSR = 1019.93 SER = 14.279 DW Stat = 2.3798)

- Arms imports equation:

AI = -105.96 - .716ME - .04TI + 93.23PAF + .037GNP
(-44) (-.73) (-.48) (.05) (.47)

(SSR = 6382.79 SER = 35.73 DW Stat = 2.0718)

b. Forecasting Model

- Military expenditure equations:

ME = -339.39 - .78LME - .27LAI +
(-2.49) (-1.4) (-.65)

.09LGNP + .165LCGE - 2694.7LPAF
(7.57) (3.02) (-2.6)

(SSR = 429.57 SER = 11.97 DW Stat = 2.3175)

- Arms imports equation:

AI = 121.46 + .01LME - .05LAI -
(.29) (.006) (-.04)

.02LGNP + .01LTI - 584.22LPAF
(-.18) (.09) (-.15)

(SSR = 7228.46 SER = 49.0845 DW Stat = 1.9847)

As in the Philippines and Singapore, the forecasting model for Thailand showed better results for military expenditures estimation and worse for arms imports estimation than the econometric model. The t-statistics of arms imports estimation for both models shown very low values. The results of SSR and SER for military expenditures in the forecasting model, and for arms imports in the econometric model were better than their counterpart, military expenditures in the econometric model and arms imports in the forecasting model. Analysis of the actual data to trace what factors affect the estimation will be described below.

Two outliers in the arms imports data in 1968 and 1973 can be explained as the boom of arms transfers from the US to this area at the beginning of the Vietnam war and the intensive fights before the downfall of the South-Vietnam, Cambodia and Laos to the communists. The outliers were not affected by the amounts of military expenditure, GNP and PAF in those specific years.

B. ON THE ASEAN ALLIANCE AS A WHOLE

Since the estimation included all of the five countries of the ASEAN alliance as a whole, the above estimated simultaneous equation model can be applied to both the econometric and the forecasting models with nine years and five countries observation, that is a sample size of 45. Two endogenous variables (current ME and AI) and four exogenous variables (current GNP, CGE, TI and PAF) in the econometric model, and six predetermined variables (lagged endogenous LME and LAI, and four lagged exogenous LGNP, LCGE, LTI and LPAF) in the forecasting model were used in this estimation. Both models were run through the FIML program in TSP.

1. Econometric Model

$$\underset{(-4.38)}{ME = -996.13} + \underset{(.5)}{.01GNP} + \underset{(1.83)}{.019CGE} - \underset{(-.9)}{133.76PAF} + \underset{(27.16)}{31.84AI}$$

(SSR = 319204 SER = 799.004 DW Stat = 1.3886)

$$\underset{(4.27)}{AI = 29.2} - \underset{(-1.11)}{.02ME} + \underset{(2.2)}{.002TI} + \underset{(1.34)}{6.07PAF} + \underset{(.84)}{.001GNP}$$

(SSR = 209778 SER = 68.277 DW Stat = 2.1649)

2. Forecasting Model

$$ME = \underset{(.99)}{25.68} + \underset{(9.46)}{.88LME} - \underset{(-.57)}{.26LAI} + \underset{(1.51)}{.006LGNP} + \underset{(-.02)}{.003LCGE} - \underset{(-.08)}{15.75LPAF}$$

(SSR = 209778 SER = 21.6225 DW Stat = 2.5125)

The t-statistics in the estimated coefficients which have positive signs are always more significant than which have negative signs. It means that in all events, the increase in the predetermined variables will imply the increase of the predicted values of military expenditures and arms imports.

Analyzing the results of the t-statistics, the sum of squared residuals and the standard error of the regression, it turns out that the forecasting model in this simultaneous model has better results than the econometric model on both the military expenditure equation and the arms imports equation. The Durbin-Watson statistics in the econometric model indicated positive serial correlations in both equations. In the forecasting model, only did the arms imports equation indicate a small extent of negative serial correlations.

To check the results geometrically, the data set of ME, AI, GNP, CGE, TI and PAF in 1968-1976 are applied to both the econometric and forecasting models. The plots of ME and AI for both econometric and forecasting models can be seen in Figures IV.1.a and b, IV.2, IV.3 and IV.4.a and b. Figures II.5, IV.1 and IV.4 are plotted twice, Figures a are simultaneous plots and Figures b are plotted separately by individual country data due to many similar values occurs during same years.

In the econometric model, the plots of the predicted values of ME (Figures IV.1.a and b) are similar to the plots of the

actual values of AI (Figures II.5.a and b), and the plots of the predicted values of AI (Figure IV.2) are only slightly similar to the plots of the actual values of ME (Figure II.4). That explains the behavior of simultaneity of the econometric model. In this case, the military expenditures seem to be more dependent than the arms imports, i.e., a small change in arms imports values will affect the military expenditures values, while some changes in military expenditures values might or might not affect the values of arms imports.

In the forecasting model, the plots of the actual values (Figure II.4) and the predicted values of ME (Figure IV.3) are similar to the plots of actual values (Figures II.5.a and b) and the predicted values of AI (Figures IV.4.a and b). These similarities explain the success of using lagged variables, both endogenous and exogenous, in the forecasting model.

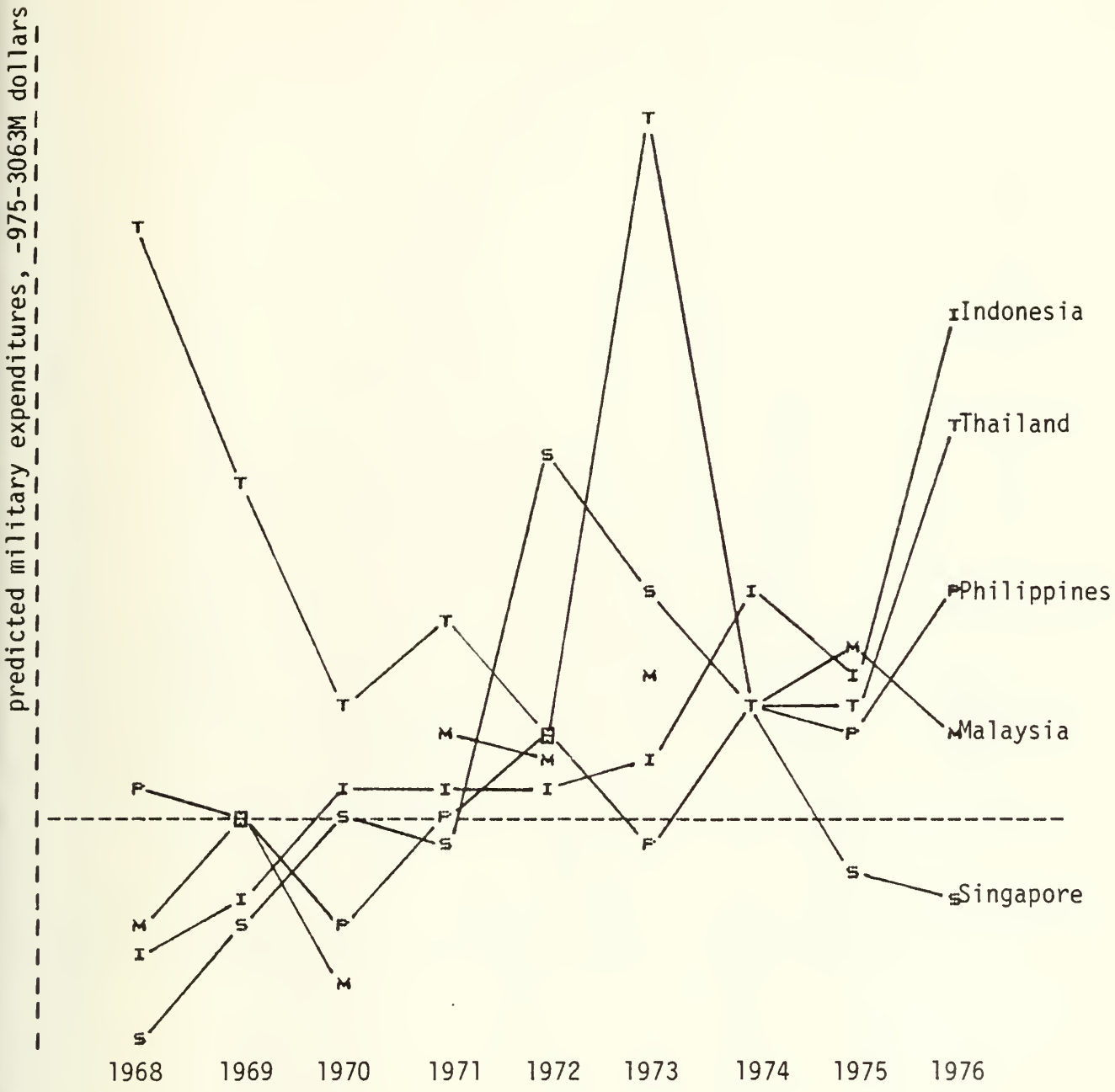


FIGURE IV.1a

The plots of the predicted values of military expenditures in the econometric model 1968-1976

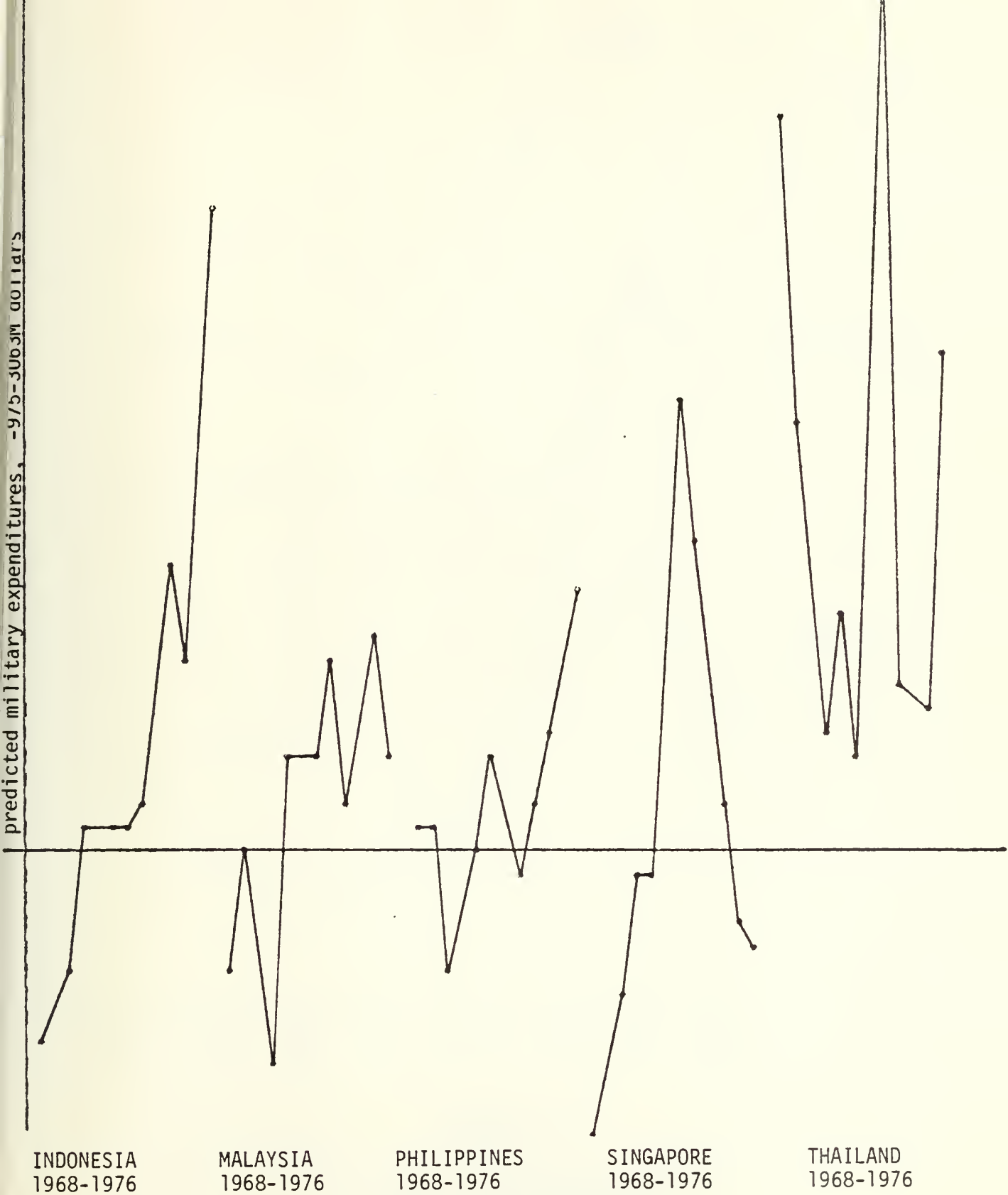


FIGURE IV.1b

The plots of the predicted values of military expenditures in the econometric model 1968-1976 (country data are plotted separately due to many similar values occurs during same years.)

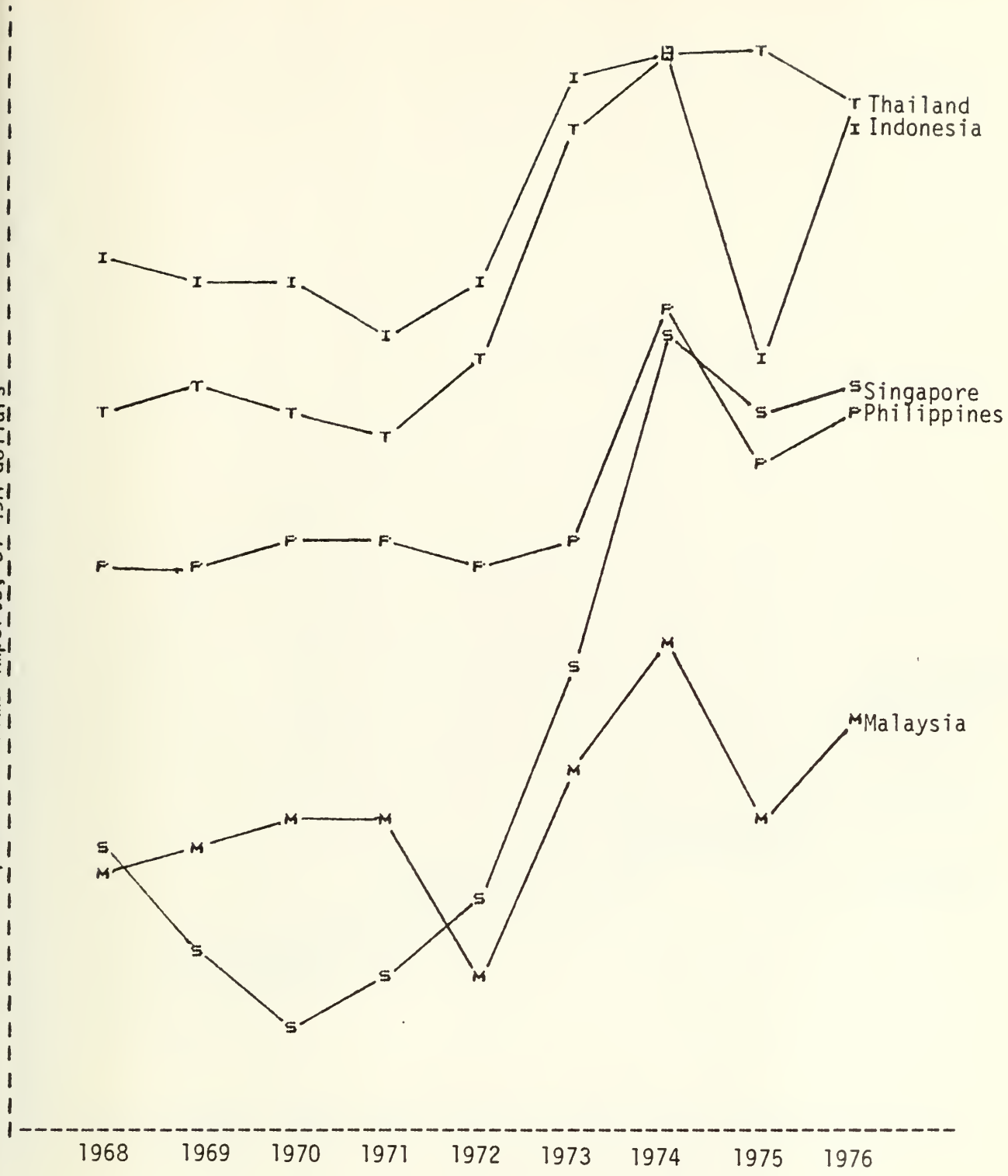


FIGURE IV.2

The plots of the predicted values of
arms imports 1968-1976

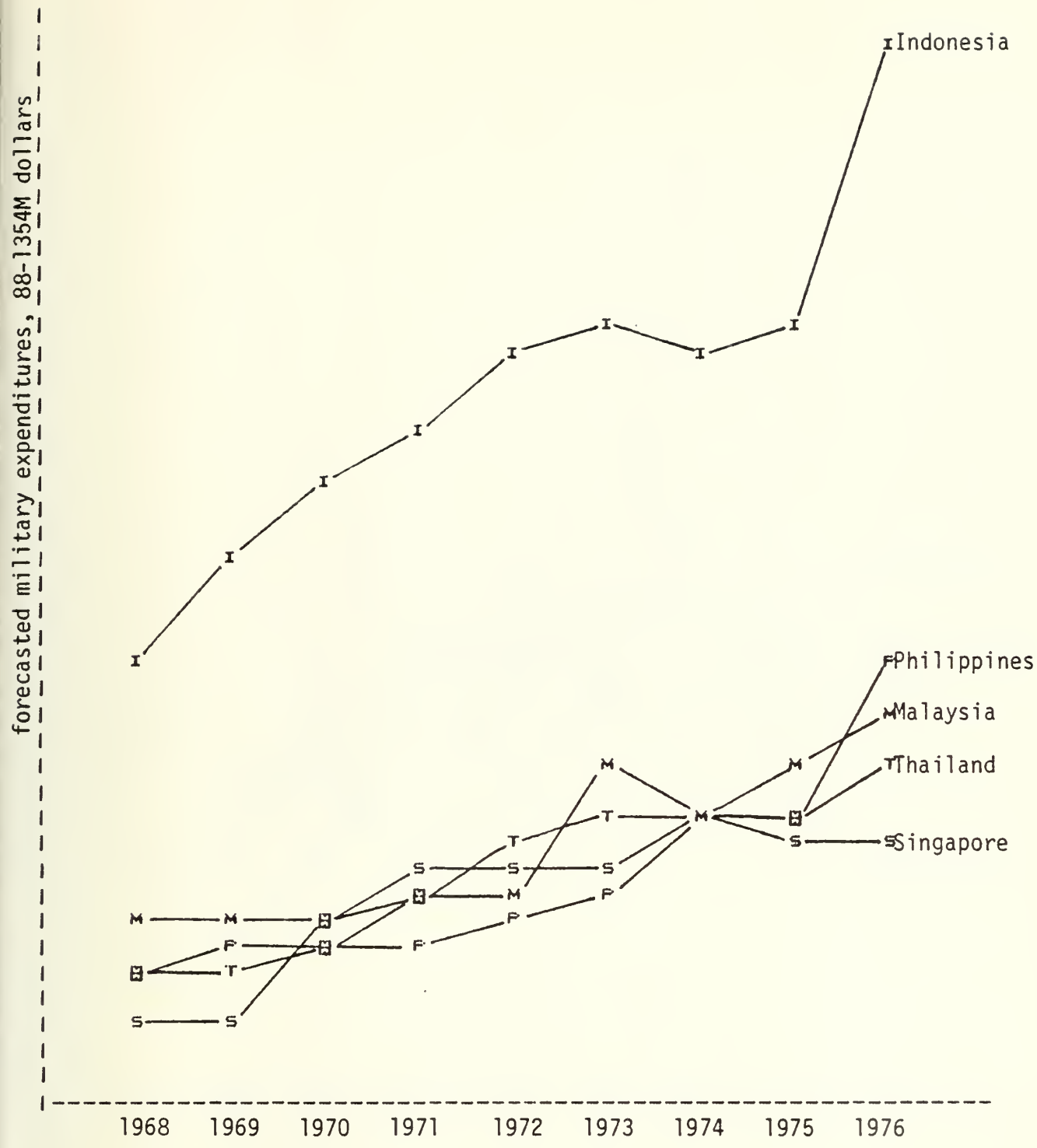


FIGURE IV.3

The plots of the forecasted values of military expenditures 1968-1976.

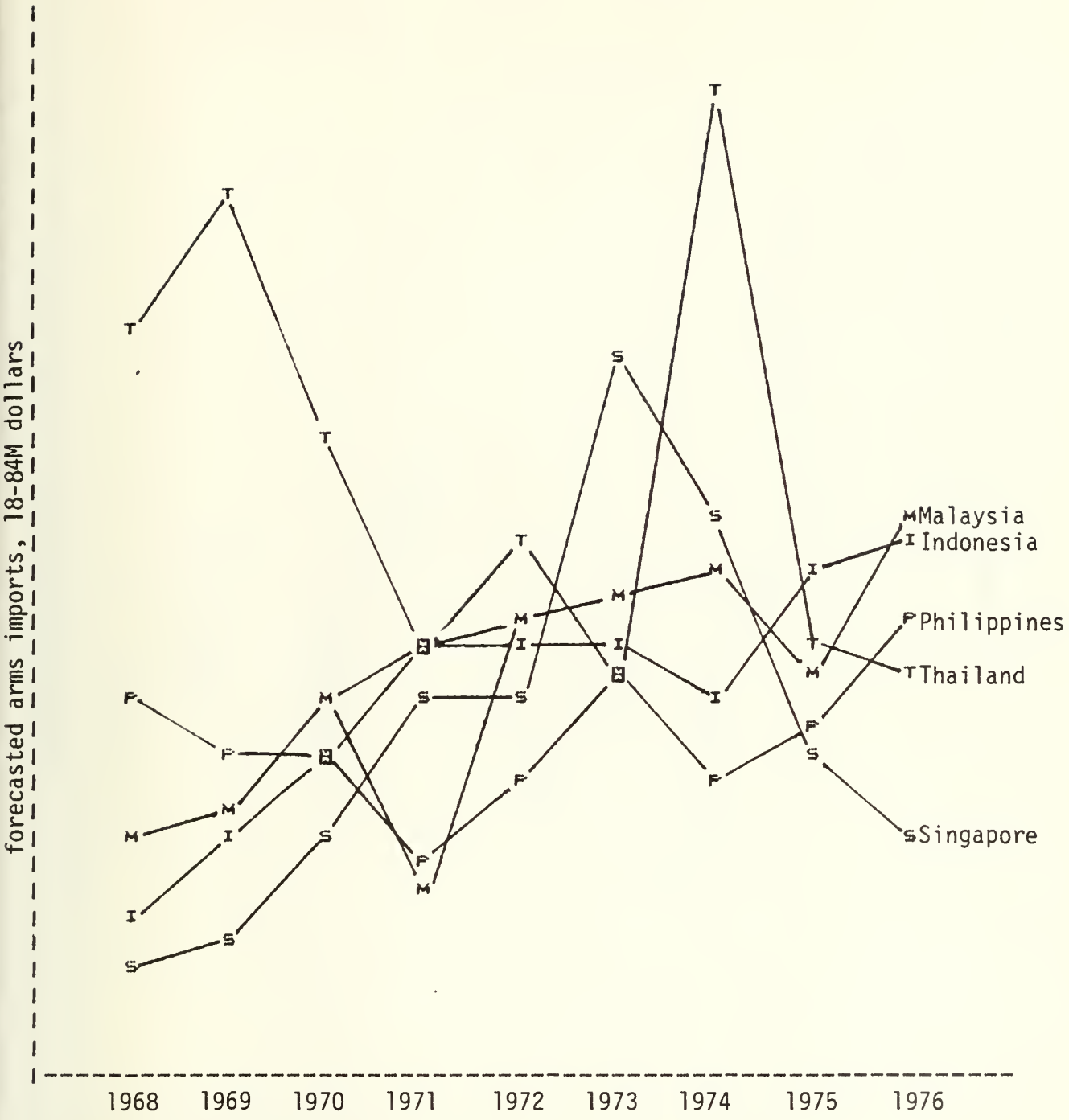


FIGURE IV.4a

The plots of the forecasted values
of arms imports 1968-1976

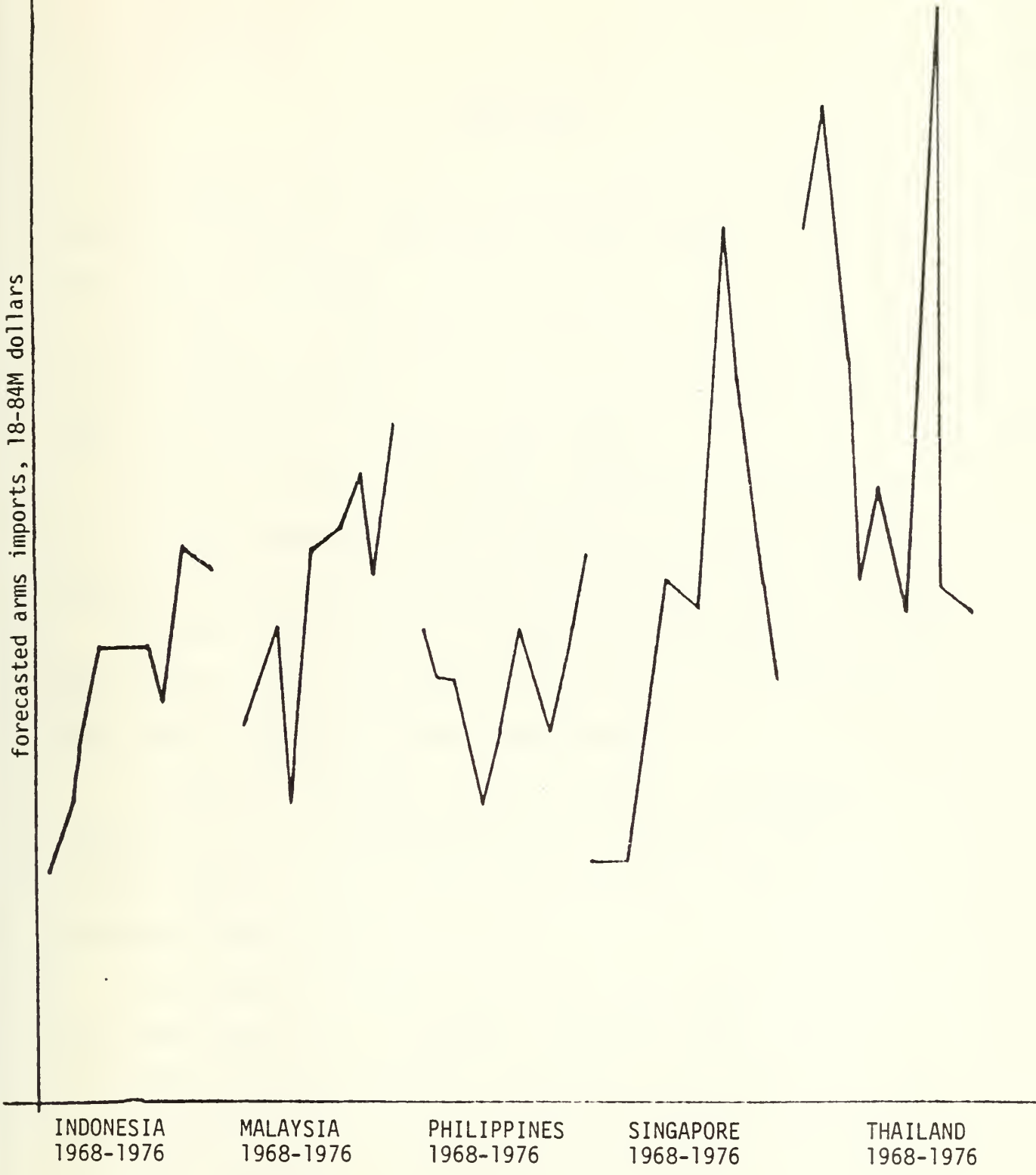


FIGURE IV.4b

The plots of the forecasted values
of arms imports
1968-1976

(country data are plotted separately due to
many similar values occurs during same years.)

V. CONCLUSION

The proposed models emphasize the significant role of the simultaneity of the military expenditures and arms imports in all of the five nations of the ASEAN.

As a part of the third world, the ASEAN nations have experineced military expenditure growth. The reasons for this growth in some cases, parallel with the study by Whynes [12]:

- Security: ASEAN nations have the same threat, the communists.

- Internal repression: With the ethnic diversity described in Chapter Two, each of the ASEAN countries has its own internal problems.

- Military vested interest: To maintain the military role in their administration, most of the ASEAN nations need to build up their military power by increasing military expenditures.

- The need of ideology and national identity: As developing countries, all of the ASEAN nations need to show their ideology and national identity, and these need military strength, which of course increase military expenditures.

In the analysis in Chapter Four, though the t-statistics did not always show significance, the models successfully demonstrated that the military expenditure growth is affected by the changes of the exogenous variables, i.e., gross national product, central government expenditures, population of the armd forces and total imports, and by the other endogenous variable, arms imports. Military expenditures seems to be more dependent than arms imports.

The forecasting accuracy test that was done in Chapter Three dealt only with ex-post forecasting. Since the model does not have the predicted values of GNP, CGE, TI and PAF, the ex-ante forecasting must have a way to include the values of the lagged exogenous variables in predicting the endogenous variables.

The forecasting model can be modified to a simulation model to forecast the values of military expenditures and arms imports in some future years. This simulation model uses the predicted values of ME and AI as the predetermined variables LME and LAI, and using the trend rate of exogenous variables, were obtained from applying the nine years observations (1967-1975) to the forecasting model, is used to compute the values of the predetermined variables LGNP, LCGE, LTI and LPAF. Further discussion and analysis of the simulation model is beyond the scope of this thesis. The idea might be useful in the policy analysis of the arms transfers behavior within ASEAN countries.

LIST OF REFERENCES

1. Fryer, Donald W., Emerging Southeast Asia, 2nd ed., p. 27-28 and p. 55, Wiley, 1979.

2. Pauker, G. J., Golay, F. H. and Enloe, C. H., Diversity and Development in Southeast Asia, p. 36-39 and p. 152-156, McGraw-Hill, 1971.

3. Far Eastern Economic Review, ASIA 1979 Year Book, p. 49-51 and p. 122-125, 1979.

4. Pinkyck, R. S. and Rubinfeld, D. L., Econometric Models and Economic Forecasts, p. 104-115, McGraw-Hill, 1976.

5. Ra'anan, Uri, Pfaltzgraff Jr., R. L. and Kemp, Geoffrey, Arms Transfers to the Third World, p. 87-93, Westview Press, 1978.

6. Johnston, J., Econometric Methods, 2nd ed., p. 352-361, McGraw-Hill, 1976.

7. Glickman, N. J., Econometric Analysis of Regional System, p. 39-43, Academic Press, 1977.

8. Intriligator, M. D., Econometric Models and Techniques and Applications, p. 515-529, Prentice Hall, 1978.

9. U.S. Arms Control and Disarmament Agency, World Military Expenditures and Arms Transfers, 1968-1977.

10. Bedlington, Stanley, Malaysia and Singapore, p. 109, Cornell University Press, 1971.

11. Chu, Kong, Principles of Econometrics, p. 96-99, International Textbook Company, 1968.

12. Whynes, David K., The Economics of Third World Military Expenditures, p. 16-30, University of Texas Press, 1979.

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